



JPRS Report

Science & Technology

Europe

19980518 248

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

Science & Technology Europe

JPRS-EST-92-034

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10 November 1992

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ADVANCED MATERIALS

German Research Ministry To Fund "Adaptronics" Research

93MI0005 Bonn WISSENSCHAFT WIRTSCHAFT
POLITIK in German 2 Sep 92

[Text] Federal Research Minister Heinz Riesenhuber plans to increase funding for intelligent structures—a concept extending beyond windowpanes that regulate their transparency. The buzzword of the future is adaptronics. Whenever the aerodynamic profile of a wing adapts to prevailing flight conditions, or windowpanes "decide" how much light to admit, they are using smart materials, or at any rate materials falling within the category of adaptronics.

The BMFT [Federal Ministry of Research and Technology] is currently considering whether this relatively new field has development potential as a funding priority area. Adaptronics covers a very wide range of applications, including, though by no means restricted to, the automobile, construction, aerospace, and mechanical engineering industries, medical technology, and microsystems engineering. It centers on multifunctional elements that carry out at least two systems-specific functions, the most familiar components of multifunctional elements being:

- Shape-memory materials, which change back and forth according to temperature between two "learned" shapes, or resume a defined shape on reaching a trigger temperature after plastic deformation;
- Electroviscous or magnetoviscous fluids able to adapt their viscosity over wide ranges in response to an electrical field;
- Piezomaterials, which either alter their position when a voltage is applied or, vice versa, generate an electric voltage in reaction to changes in their length;
- Optical-fiber sensors, which, when embedded in a structure, detect destruction, including internal destruction;
- Electrochromic, photochromic, and thermochromic layers, which provide targeted control over the degree of transparency; the latter includes the aforementioned windowpane which turns darker in the summer and admits all the available light in winter.

The results of a questionnaire in Lower Saxony showed that industry is primarily interested in adaptronics developments that give greater scope for systems monitoring, although these new technologies also have potential in other areas, such as active vibration absorption.

It is hoped that adaptronics will at last provide researchers and developers with the overall perspective that they have long been seeking. Whereas components such as sensors, activators, and control mechanisms have been constructed separately when combined to form a system, it will foster an integrative approach. The reverse side of the coin is that adaptronics is particularly

difficult to promote owing to what Riesenhuber calls its "extreme interdisciplinarity" as this is precisely what German science continues to be short of. But companies, too, find it hard to take that crucial look over the (competitor's) fence.

Level IV

- System:

—Aircraft

Level III—Control loop

- Intelligent structure

—Sensor/Actuator/Control (*must be present but can be distributed over various components*)

- Intelligent wing

Level II

- Multifunctional element. Each element has several functions (e.g. substrate + sensor + actuator):

—Shape-memory material plus trigger mechanism

Level I

- Material with "interesting" properties: e.g. sensor option + stability + heat resistance:

—Shape-memory material

AEROSPACE

Hypersonic Wind Tunnel for Hermes Testing Described

92BR0665 Paris SCIENCES ET AVENIR in French
Aug 92 pp 38-39

[Article by Jacques Morisset: "Hermes: Wind Tunnel at Mach 20"]

[Text] The most powerful hypersonic wind tunnel in the world has just been opened near Toulouse. Its aim is to simulate the very high speeds encountered when spacecraft reenter the atmosphere. In just tens of milliseconds it attains fantastic results: pressure of 2,000 bar, temperatures of up to 8,000°C, flow rates of 5,500 m/s. The first model to be tested in this monster: Hermes.

A very-high-speed wind tunnel has just been opened in Fanga, near Toulouse, by the National Aerospace Study and Research Center (ONERA). The decision to build this hypersonic wind tunnel, named F4, was made in 1988 by the European Space Agency (ESA) and the CNES [National Center for Space Research] so as to produce an optimal simulation of the highly specific conditions encountered at a spacecraft's reentry into the earth's atmosphere. Consequently, F4 is a facility which is very closely linked to the Hermes program. Indeed, it is even essential for the program's further development

as the thermo-aerodynamic phenomena experienced upon reentry are poorly understood, and the very high speeds observed (20,000 km/h) combined with intense heat may well cause the oxygen and nitrogen to dissociate.

The principle of the F4 wind tunnel is not new: Several facilities of the same type have already been built by the ONERA (and the EDF [French Electricity Company]) in Fontenay-aux-Roses. They function according to a simple principle: an intense electric arc is created inside a chamber containing air or nitrogen. This chamber is linked to a vacuum chamber by a duct (pipe) with a painstakingly researched profile which is designed to ensure a homogeneous flow. The pipe is blanked off by a plug which "pops out" when the pressure reaches a certain level inside the arc chamber as a result of the heat generated by the passage of the electric arc. The hot gas then escapes violently into the test chamber before passing into the vacuum chamber.

The generation of such a high-intensity electric arc as required for the F4 requires an amount of energy that cannot reasonably be supplied by the EDF on such a sporadic basis. This problem has been solved by storing the necessary energy in a 15-ton flywheel which is gradually brought up to its economic speed (6,000 rpm) by a 150-MW alternator functioning as a variable-frequency synchronous motor. The stored energy represents 400 megajoules. In order to generate the arc, the electric motor circuit is disconnected, the rotor is excited, and the alternator feeds a continuous current into the arc chamber via a diode bridge rectifier and a fusible conductor. These electrodes, which are spiral in form, produce a magnetic field which drives the rapidly rotating arc to their edge so as to reduce their erosion.

Naturally, the duration of this arc is very short: just tens of milliseconds. The wind blast generated after the ejection of the plug has a useful duration of roughly 100 milliseconds before it is interrupted by the opening of a delivery valve. Consequently, the entire unit is controlled and checked by automata that are themselves subject to the control of a monitoring system which feeds them successive orders with a precision of 0.5 millisecond.

The pressure in the chamber is measured by several sensors, as is the temperature, which serves as a basis for calculating the average enthalpy (latent heat). The tested model is mounted on a "pin," so as not to disturb the flow. A motorized support enables rapid variation of its angle (20° in 50 milliseconds). The inertia-compensated scales inside the pin were developed especially for Hermes; an artificial feel system can then be used to determine the stress to which the model is subjected on the three conventional axes (pitch, rolling, yawing) and, in particular, to trace the polar curve which can be used to represent relative variations in lift and drag as a function of the angles of flight.

The entire operation is carried out within a very short space of time (less than one-tenth of a second!) and the data are digitally stored via an acquisition string comprising 72 autonomous channels of measurement. The acquisition rate may be as high as 50 kHz (50,000 measurements per second) per channel, and a rapid memory makes it possible to store 64,000 16-bit words per channel. Measurements are also made of the peripheral pressures and heat flows. The technicians estimate that they will be able to carry out five tests per day. This figure takes account of the need to restart the pulsed machine, drain the circuit, and check the condition of the arc chamber. The latter is a new design—compared with the one at Fontenay (ARC 2)—involving technological advances; for instance with respect to the insulators between the electrodes and the electrode-holder, or the insulation of the liner, i.e., the metal wall of the chamber.

Following experiments conducted for one year using an atmospheric chamber, a chamber recovered on ARC-2, and, finally, the chamber designed for F4 filled with nitrogen at first and with air in a subsequent stage, the technicians are now certain of obtaining the expected results; in other words, flow rates of approximately 5,500 m/s (nearly 20,000 kph) for initial pressures of 2,000 bar and temperatures of 8,000°C. To date, pressures of 1,000 bar and temperatures of 5,000°C (air) or 6,000°C (nitrogen) have been obtained. Because it is a hot—indeed, even a very hot—wind tunnel, once the above-mentioned calculation codes have been confirmed, F4 should make it possible to extrapolate measures made under the actual conditions of reentry into the earth's atmosphere.

If this is indeed the case, the Fr88 million invested in the operation—40 million of which were provided by the French government, 28 million by the ESA, and 20 million by the Midi-Pyrenees region and the department of Haute-Garonne—will have proved worthwhile. Moreover, the CNES is firmly convinced that this will be the case. Its deputy director-general stated quite clearly in Toulouse that the CNES was determined to support the ONERA in developing its research and methods of aerothermic testing which will be indispensable if Europe is to develop not just a space shuttle, but also the hypersonic aircraft of the future. The president of ONERA, Mr. Benichou, stated that he was convinced that F4 would be in use for several decades; in other words up to 2030 or 2040, when the first hypersonic scramjet aircraft go into service. So watch this space...until 2040.

ESA Interorbital Communications Experiment Described

92BR0724 Toulouse LA LETTRE DU CNES in French
Jun 92 pp 5-8

[Unattributed article: "IOC: An Experiment in Interorbital Communications"]

[Text] IOC [Inter-Orbit Communications] is an experimental program developed by the European Space Agency (ESA). It aims to manage a bidirectional Ka-band link (20/30 GHz) between a low orbiting satellite (Eureca A) and a ground station using a geostationary satellite (Olympus) as a relay.

The in-flight behavior of the IOC payload fitted onto Eureca and the results of its use during the preoperational phase will initially be of great importance for SILEX [Semiconductor Laser Intersatellite Link Experiment] and later for the future ESA relay satellite (DRS).

Eureca's launch from Cape Kennedy on the American space shuttle Atlantis is planned for the morning of 21 July 1992.

IOC is the first European intersatellite communications experiment. The CNES (French [National Center for Space Studies]) was the ESA's main contractor.

Aim of the IOC System

The main aim of the IOC system is the in-flight testing and demonstration—on a preoperational basis—of the functions, services, and equipment required for a relay satellite system (DRS). This involves tracking a user spacecraft with a geostationary relay satellite, tracking the relay with a user spacecraft, the bidirectional transmission of data between the user spacecraft and a ground station via the relay, and, lastly, services such as telemetry, remote command, and distance measuring (for locating purposes) for the user spacecraft via data relay.

To achieve this goal, IOC uses the low orbiting (500 km) Eureca A as a platform to carry the IOC terminal and the Olympus geostationary satellite as a data relay.

Using the 20/30-GHz (Ka-band) payload on the Olympus, the IOC system manages the following streams of data:

- Transmission of high-speed (512 kbps) Eureca measurements;
- Transmission of IOC test data at 2 Mbps, 1 Mbps, 500 kbps, and 250 kbps for assessing the quality of transmissions;
- Receiving Eureca remote control commands (2 kbps);
- Reception and retransmission of distance measuring signals using the ESA "ranging tone" standard.

System

IOC Payload

The IOC payload on Eureca is the final part of the 20/30-GHz link. The payload comprises a directional antenna aimed at Olympus. Tracking is controlled by the IOC on-board computer, in either an open or closed loop.

Olympus

IOC links are retransmitted by the 20/30-GHz payload on-board Olympus. This payload comprises two steerable antennas: one aimed at the Eureca satellite, and the other at the IOC ground station.

Eureca Control Center

The Eureca control center, located in Darmstadt, controls and monitors the IOC payload. In particular, the center calculates the remote commands used by IOC to aim its antenna toward Olympus, depending on the relative positions of Eureca and Olympus. These remote commands are then automatically loaded into IOC via Eureca by using either Eureca S-band direct or IOC Ka-band transmissions. The Eureca S-band TTC station is located in Maspalomas (Grand Canary).

Olympus Control Center

The Olympus control center, located in Fucino (Italy), is responsible for sending commands to Olympus to enable it to situate the IOC payload.

IOC Ground Station

The IOC ground station comprises a 20/30-GHz station linked to a special IOC terminal called IFOTT [In-Flight Operational Test Terminal].

IFOTT is used during hookup and also measures the performance of the transmission (bit error rate, frequency, power, etc.). In addition, it displays IOC remote control measurements [telemesure de servitude] from the Eureca S-band station. It is not, however, used to send automatic commands to IOC.

Payload

Front Housing

The front housing is the mobile part of the IOC. It transmits/receives at 20/30 GHz and also converts the frequency to 2 GHz. This frequency conversion had to be included because it was impossible to route Ka-band signals through the cable reels in the antenna aiming mechanism.

The forward housing comprises:

- A Cassegrain antenna measuring 55 cm in diameter with a central horn for sending/receiving at 20/30 GHz. This antenna is fitted with an RF [radio frequency] sensor for closed-loop tracking;
- A 20/2-GHz step-down frequency converter;
- A 2/30-GHz step-up frequency converter;
- A 10-W, 30-GHz traveling wave tube and associated power supply.

Antenna Aiming Mechanism

The antenna aiming mechanism supports the front housing and aims the IOC antenna in the direction requested by on-board computer. It consists of two devices that permit rotation around two perpendicular axes, one along the azimuth, the other in elevation. These two devices are linked by a carbon fiber support.

Each axis is rotated by microstep-controlled step motors. The axes are powered directly by the motors. There is no transmission box, so mechanical play is reduced to a minimum.

To route electrical signals between the front housing and the auxiliary structure, each unit has a reel containing and 34 flexible flat cables wound in a spiral. The overall precision of the antenna-aiming mechanism is 0.01°.

To lock the front housing during periods of IOC inactivity and during the reentry phase, each axis of the aiming mechanism is fitted with two redundant electromagnetically activated locking devices. Following a command from the on-board computer or in the event of a power cut, these devices lock the two axes and hold the front housing in a fixed position.

Auxiliary Structure

This structure, fitted onto Eureka, supports the following equipment:

- The antenna aiming mechanism fitted with the forward housing;
- Electronics for the aiming mechanism, which generates current for the step motors according to instructions from the on-board computer, manages the locking devices, and receives and transmits remote measurements from the coders of the two motor axes to the on-board computer;
- The supply unit, which distributes the electrical energy provided by Eureka to the various pieces of equipment in the IOC payload. The nominal power of the entire payload in operating mode is 140 W;
- The on-board computer. Depending on the commands from either the ground station or the Eureka platform, the on-board computer monitors and inspects the IOC payload. It controls the following main functions:

- It distributes remote control commands to the corresponding IOC equipment and collects their data.
- It controls the temperatures of the various IOC elements and cuts the electrical supply if the equipment overheats.
- In real time, it calculates the values of the control currents for the motors in the antenna aiming mechanism. This is calculated using aiming tables that are loaded remotely from the ground (open-loop tracking) or on the basis of data provided by the RF sensor (closed-loop tracking).
- It handles the exchange of remote measurement/remote control data using the Eureka central data management system.
- It generates test data. This data consists of a stream of pseudo-randomly coded bits flowing at 2,000, 1,000, 500 and 250 kbits/s, used on the ground to measure the bit error rate of the return transmission.

The S-band repeater. On the receiving channel, the S-band repeater:

- receives the 2-GHz carrier from the step-down frequency converter;
- demodulates the remote command subcarrier and transfers it to Eureka;
- demodulates and filters the tones from the distance-measuring signal.

On the send channel, the S-band repeater transmits the 2.2-GHz carrier to the step-up frequency converter in one of the following forms:

- in a pure carrier wave for the transmission of the marker signal;
- in a modulated carrier wave for the binary stream emitted by the on-board computer (test data from the IOC or the transmission of remote sensing data);
- in a phase-modulated carrier wave by the tones of the distance-measuring signals.
- The locking system, which is a triple-contact mechanism enabling the entire aiming mechanism/front housing to resist vibrations during the launch of the U.S. space shuttle. Given a command from the on-board computer, the locking system electronics control the release of the mechanism, using pyrotechnic devices with redundant ignition. Following this operation and throughout the life of the IOC, including during recovery, descent, and landing phases, the front housing is held in place by the locking devices alone.

Physical Specifications of the IOC Payload

Mass	67 kg
Height	850mm
Length	1,400mm
Width	700mm

Aiming the Antenna

Remote Input of the Antenna Aiming Tables

Recognizing the relative positions of Eureka and Olympus, IOC aiming tables are generated at the Eureka control center and then remotely loaded into the IOC during S-band contacts with Eureka, or during Ka-band contacts via Olympus.

These aiming tables are drawn up for a period of 48 hours. Nevertheless, nominal provisions are made for remote loading every 24 hours. Furthermore, the Olympus control center generates and remotely loads Olympus with antenna aiming tables in order to track Eureka.

Achieving Hook-Up

At the beginning of the visibility period, the IOC and Olympus antennas take the planned directions. The IOC sends a beacon signal to the ground via Olympus. After

reception—and following adjustments for the Doppler effect-related frequency deviation (relative deviation between Olympus and Eureka)—the ground station scans the frequencies of the outbound link around the nominal frequency of the IOC. Once the frequency on the outbound link is within the hook-up range of the on-board receiver, IOC sends a modulation on the return link. When this modulation is present, the ground station knows that the on-board receiver is hooked up. The frequency scan is then stopped. The link is now established and can be maintained throughout the IOC-Olympus visibility period (about 57 minutes per orbit).

Open-Loop Tracking

After hook-up, the on-board computer controls open-loop tracking by using the aiming table and taking account of the difference in Eureka's attitude with

respect to its nominal attitude. This information is provided periodically by the Eureka central computer.

Closed-Loop Tracking

After starting open-loop tracking, it is possible to continue with closed-loop tracking. Closed-loop tracking is performed on the basis of data provided by an RF sensor in conjunction with on-board processing. The antenna beam is scanned in four orthogonal directions by using four PIN diodes switched sequentially by the on-board computer.

The elementary displacement of the beam by a diode is caused by the generation of a higher-order mode in the supply unit. For each displacement of the beam, the CAG voltages of the S-band repeater are read and processed by the on-board computer, which determines the drift values of the azimuth and elevation angles. It then sends the commands required to bring the antenna into the correct direction.

Schedule for IOC Operation and Development

Phase A: Prime contractor MBB/ERNO	May 1983
Phase B: Prime contractor Alcatel Espace	May 1984
Phase C/D: Prime contractor CNES	August 1985
Delivery to MBB/ERNO and integration into Eureka	September 1988
Launch	July 1992
In-flight acceptance test and initial test phase	six weeks
Preoperational phase	four months
Final test phase	two weeks
Recovery	February 1993
Post-flight inspection and expert appraisal	three months

Organizational Structure

ESA (customer)	CNES (prime contractor)	CNES Project Management	-	-
		CNES PA/QA Supervision	-	-
		CNES System Supervision	-	-
		CNES Payload and Ground Segment	Alcatel (France)	-
			TEX (France)	-
			BTM (Belgium)	-
			ETCA (Belgium)	-
			LABEN (Italy)	ISEL (Spain)
			MATRA	SENER
			MDS (UK)	-
			MSS (UK)	ERA (UK)
			Selenia (Alenia)(Italy)	AEG (Germany)
			COM'DEV (UK)	-

**Agreement Allowing DASA To Acquire
51-Percent Stake in Fokker***92WS0778C Paris AFP SCIENCES in French 30 Jul 92
p 15*

[Text] La Haye—The Dutch government, which holds 31.8 percent of the capital of Holland's aeronautics manufacturer Fokker, has agreed to allow the Germany company Deutsche Aerospace (DASA) to acquire 51-percent stake in Fokker in the near future. The agreement was announced 24 July by the Dutch minister of economic affairs, Koos Andriessen, during a press conference.

The minister thus eliminated, at the last minute, the sole remaining obstacle after consulting with the House's economic affairs committee. He agreed to sell in three years whatever the Dutch state's shares in Fokker are at that time, thereby relinquishing any direct influence on the important decisions that will be made by its new board of directors, as DASA wished.

This will enable the German company, which is a subsidiary of the industrial group Daimler-Benz, to bring its partners Aerospatiale (France) and Alenia (Italy) into the holding company headed by Fokker.

The Dutch government intended to keep for as long as possible (some rumors put it at eight years) oversight over Fokker's internal management, to prevent the company from becoming little more than an assembly line for airplanes that no longer even bear its name. The agreement stipulates that a holding company will be created that will acquire a 51-percent stake in Fokker, while institutional and private shareholders split the remaining 49 percent. DASA will own a 78-percent share of the holding company itself, and the Dutch government a 22-percent share, with everything depending on the number of new shares that are issued.

Minister Andriessen did not cite any exact figures or prices. When the final contract is signed, the Dutch government will sell its present chunk of Fokker shares (31.8 percent). Half of the revenue it earns from the sale will be enough to buy a 22-percent stake in the holding company, while the other half will be put into a support fund to partially underwrite the costs of developing new airplanes. In three years, La Haye will sell its 22 percent to DASA, which will then acquire a 51-percent controlling stake in Fokker. But DASA will very likely seize the opportunity to bring Aerospatiale and Alenia into the holding company. The Dutch state will again deposit the sum it earns from the sale into the special support fund.

This plan will enable La Haye to see to it that Fokker remains a company that is responsible for its profits, as well as the chief contractor for 65- to 130-seat planes. It will also enable the Dutch government to insure that the better part of Fokker's operations, or at least 49 percent of the company's added value, remain in the Netherlands.

DLR Research Into Hypersonics Noted*92WS0792C Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 22 Jul p 8*

[Article by re: "DLR Takes Exhaust Nozzle Test Stand Into Operation"]

[Text] Frankfurt—The German Aerospace Research Institute (DLR) has begun operating an exhaust nozzle test stand at its research center in Cologne-Porz. This is a milestone in hypersonics research, the institute reports. Principally, experimental studies of exhaust nozzles for air-breathing engines will be carried out here. Such exhaust nozzles could be used in the reusable spacecraft based on the Saenger concept. The exhaust nozzle is to produce the required thrust by means of variable geometry over the entire range of flight of the lower stage, that is to say from start to stage separation and back to the ground.

As further reported by the DLR, the air-breathing engine is a ramjet in the higher speed range. The required combustion pressure is thereby produced by damming the air streaming through the engine. The hydrogen is injected as fuel into the compressed and already quite hot air and immediately burned, whereby temperatures up to 2,700°C can result.

In the subsequent expansion nozzle, thermal energy is largely converted to thrust force. The test stand will now simulate flight conditions. The thrust is measured with a high-precision scale and the flow field in the interior of the nozzle analyzed with optical measuring methods.

Because of the use of hydrogen, according to information from the DLR, the test stand is also suitable for studying hydrogen technology and could thus be used in environmentally related development tasks to reduce carbon dioxide production. Questions involving combustion chamber design, flow and reaction engineering, nitrogen oxide-formation, material selection and cooling methods could be answered through experiments at this test stand.

Furthermore, new optical test methods are being used to analyze the high-temperature processes, which has considerably expanded the application area of the latter, in the DLR's opinion. In general, this benefits flow-free test technology. Finally, studies of materials and construction methods for thermally highly stressed components are also among the application fields for this new test facility, which cost approximately 10 million German marks and is unique in Europe in its concept.

DLR Studies Reduction of Air Turbulence*92WS0792E Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 28 Jul 92 p 8*

[Article by re: "Fly More Economically With Laminar Flow"]

[Text] Frankfurt—Aircraft manufacturers are now devoting more attention to improving the flow conditions on the fuselage and wings, because less air resistance means fuel savings and that, in turn, means greater profitability when operating the aircraft. By getting an aerodynamically better profile, possibly up to 20 percent less air resistance could be achieved. For this the profiles must be designed so that the air streaming past them does not create turbulence but flows smoothly (laminar) along the upper surface of the profile, reports the German Aerospace Research Institute (DLR) in Cologne-Porz.

The DLR is studying the advantages of laminar flow control in three experiments. Among them is the use of a test profile called a laminar glove on an aircraft of the Do 228 type. The first evaluations have confirmed the experience of earlier flight tests. The drag coefficients achieved are about 50 percent below those of conventional wing profiles.

In another project DLR aerodynamicists, together with engine manufacturers Rolls-Royce and MTU [Motoren- und Turbinen-Union GmbH], are studying the possibility of keeping the surface flow at the engine nacelles laminar as well. This is of major significance primarily because today's surfaces on the cowl of the large bypass engines already represent up to 20 percent of the surface of an airfoil, it was further said. The conditions which are studied here are on the test aircraft Attas.

As further reported by the DLR, in designing the swept-back wings of large commercial aircraft the aerodynamicists will have to rely on the trick of boundary layer control at the rudder unit in order to achieve the longest possible laminar flow, which is likely to be rather expensive in practice: To do so it is necessary to supply the surface with tiny holes of 0.06 millimeter diameter or with slits with a width of 0.1 millimeter. Furthermore, this needs a fail-safe mechanism with suction channels, pressure reduction and suction compressors as well as automatic suction control.

In cooperation with Airbus Industries and the French space research agency ONERA, DLR intends to study this so-called hybrid laminarization by means of a 1:2 scale model of the rudder unit of an Airbus A 320 in its Braunschweig low-speed wind tunnel and in the French transsonic wind tunnel. Later, a suction rudder unit will also be tested in flight on an Airbus. In the United States a suction device has already been tested on a Boeing 757 aircraft in a flight experiment.

Germany: Riesenhuber Discusses Future of Europe's Manned Space Program

92WS0796B Duesseldorf VDI NACHRICHTEN
in German 14 Aug 92 p 3

[Article by Wolfgang Mock: "Manned Space Flight Faces Empty Coffers"; first paragraph is editor's lead]

[Text] When the European ministers for space meet in Spain in mid-November to decide on a joint space program for the next few years, there will be plenty to talk about: the major space nations in particular, such as France, Italy and Germany, are faced with empty coffers. The first victim: the HERMES space glider.

Only three Europeans came back to earth from space last weekend: the Frenchman Michel Tognini landed in the Caucasian steppes after an almost two-week voyage to the Russian Mir space station; the Swiss Claude Nicolier and the Italian Franco Malerba landed at Cape Canaveral after nine days in space together with five U.S. astronauts in the shuttle Atlantis.

While Tognini's mission to the Mir space station proceeded routinely, Nicolier and Malerba had greater problems on board the U.S. shuttle Atlantis: the reusable research satellite Eureka could only be inserted into the correct orbit after some difficulties, and the experiment in which a small satellite was to be deployed on a 20-km long cord was a failure.

Still, that made six Europeans who have been in space since the beginning of the year. But they were always traveling as paying guests. A flight to the Mir space station, including the scientific experiments, costs about DM40 million, while going along on a U.S. shuttle is somewhat more expensive: the D-2 mission planned for mid-February 1993 will cost almost DM800 million. But then two Germans with more than 90 experiments will also be flying around the earth on an American shuttle for nine days.

As things look now, the Europeans will remain paying guests on American space flights or Russian space stations for the next few years, if not decades. As recently as last week, Heinz Riesenhuber, the Federal minister for research, once more emphasized that it would "not be possible" for Europe to have "a manned HERMES by the year 2000."

But that is not all. The European space agency ESA had already suggested in the spring that the manned version of HERMES be given up for the moment and that only an unmanned space glider on a 1:1 scale be built under the name X2000, to be launched into space at the end of the year 2000. But Riesenhuber "seriously doubts" if even the DM6.5 billion necessary for the X2000 can be raised by the ESA member states. And a high official of the Federal Ministry for Research is of the opinion that "the cost of the unmanned HERMES is still very much underestimated." Past experience could indicate that he is right: cost estimates for the manned HERMES rose by over 40 percent from 1987 to 1991.

Riesenhuber wants to persuade his ministerial colleagues from the other ESA member countries at their next meeting in Spain in mid-November to step back from the unmanned HERMES flight too and to investigate "other strategies" through which "long-term European competence in manned space flight" could be achieved. One variation would be a reduced HERMES model on a scale

of 1:3, with a length of barely 5 meters and a wingspan of barely 3 meters, in which the problems of re-entry into earth's atmosphere, the heat shield and navigation could be investigated.

In doing this, the Germans also hope to make the next step directly to supersonic technology via such a technological program and to develop the technical requirements for reusable spaceships with horizontal takeoff and landing. Thus, for example, the technology policy spokesman of the CDU party, Christian Lerzer, demands that HERMES be continued as a technology program "but that it be linked with supersonic technology."

According to ESA's money-saving strategy, the free-flying European space lab will also be dropped for the time being. The research lab Columbus, which is to be in fixed dockage with the planned U.S. space station, will be reduced to 60 to 80 percent of its original scope.

Riesenhuber plans to provide DM1.233 billion from his coffers for the ESA's budget. For the next few years an increase in these funds of 2.5 percent per annum is anticipated, "with which inflation rates must also be covered" (Riesenhuber). With an inflation rate which is heading straight for 4 to 5 percent, that means a real reduction in German ESA contributions.

ESA head Jean-Marie Luton, on the other hand, had demanded an average growth of 5 percent in the budget for the large space infrastructures (HERMES, Columbus and Ariane). Riesenhuber's suggestions will not only irk people in the ESA. The German and European aerospace industries definitely insist at least on the unmanned HERMES X2000. "The initially unmanned space glider HERMES," says Werner Heinzmann, "is do-able for the German aerospace industry and for the ESA." Heinzmann, who is responsible for space flight in the Daimler subsidiary Deutsche Aerospace, had tried to smooth Riesenhuber's path as early as mid-June: the industry could certainly finance the DM200-300 million which Riesenhuber lacked in the medium term for financing even the reduced ESA program.

So far Riesenhuber does not want to accept this offer. He even places cautious hopes in France, after Hubert Curien, who is now again the minister of research responsible for space flight, had indicated that he too could now finance only an annual growth of little more than 2 to 3 percent. Thus Curien too would fall short of the demands made by ESA head Luton. But Riesenhuber hesitates to count on Curien: at the last moment President Mitterrand could again make space flight a major priority, and then a growth of 9 to 10 percent in the space budget would be assured.

But in Italy economic circumstances are also visibly deteriorating, so that Riesenhuber hopes that the country "can no longer participate regardless of the rate of growth" for the space budget.

But whether in the long term there will always be a place for the Europeans in U.S. or Russian space flights in

equally unclear. The Russian space station Mir will have to be partially replaced in the future, and it is still an open question how it is to be financed. In the U.S. there is a stiff battle every year for funds for space flight; again this year Congress cut funding for the planned space station Freedom by \$500 million, a quarter of the allocated funds.

In spite of everything, ESA head Luton is already dreaming of an international moon base with European participation. But at the moment no one in the Federal Ministry for Research wants to hear much about that: "Today that would only be the kiss of death for manned space flight as a whole."

Research and Space Minister Defends European Space Program

92WS0802B Paris LE MONDE in French 22 Aug 92 p 20

[Text] "I was the midwife for Hermes, don't look to me to dig its grave!" Such was the reply of research and space minister Hubert Curien when questioned about the European space plane's uncertain future Wednesday, 19 August, during a reception given in honor of the recent Franco-Russian Antares mission. "There is no reason for us to weaken in our resolve to pursue large European space programs. We must continue to develop launchers and satellites, and there is no question of softpedaling the earth observation programs," he added, pointing out that he had not forgotten "manned flight programs."

Hermes X2000 Offers Hope for Program's Future

92WS0807F Brussels EUROPEAN AVIANEWS
in English Jul-Aug 92 pp 38-39

[Article by Theo Pirard: "X 2000 Proof of Concept"]

[Text] At the beginning of April, when Jean-Marie Luton, chairman of the ESA, was in Brussels for the VIII International Microgravity Symposium, he could not hide his fears about the future of the Hermes space shuttle.

"With the funds that we are expected to accept, it is not possible to complete—in the given period—the current programmes for the Ariane 5 heavy launcher, the Columbus orbital infrastructure and the Hermes space shuttle." Luton indicated that several scenarios were under study with a view to adapting the strategy of Europe in space during the next 15 years: "These scenarios will be decided at the beginning of this summer." European space industry, which is aware of the financial problems of Europe in space—problems which are mainly due to the present poor state of the German economy—has had to revise its ideas about the Hermes programme.

The Euro-Hermespace company, which is in charge of the industrial side of the Hermes space shuttle made a proposal in March 1991, involving a two-stage plan. This company, which was created in January 1992 at the request of the European Space Agency, brings together the main players involved in the development of the European shuttle: Hermespace (made up of Aerospatiale and Dassault Aviation) with 51.6 percent, Deutsche Aerospace with 33.4 percent, and Alenia with 15 percent. The Euro-Hermespace team is based in Toulouse and currently employs some 160 people from the four companies holding shares in it. Its chairman, Philippe Couillard, took stock of the situation regarding Hermes's future at the recent ILA '92 airshow: "We have set ourselves visible targets in the medium-term, which are necessary for those involved and for the management; they want to see concrete results by the year 2000. Europe does not have experience of atmosphere re-entry and must demonstrate that the vehicle launched by Ariane 5 is capable of withstanding the atmosphere. In order to get experience for aerodynamics and thermal protection, studies have been made of the Hermes X 2000 stage."

The proposal for a Hermes X 2000 by Euro-Hermespace takes into account the fact that investment made for studies carried out since 1985 should not be wasted; it also had to allow for budgetary limits imposed by the ESA. The solution advocated in Munich was to spread the Hermes programme over a period of time. The first automatic flight had been scheduled for 2003, followed by a manned flight one year later... But the ESA Council in Munich was not satisfied with this solution, and called for an evaluation of future collaboration possibilities with Russia. According to Philippe Couillard, "The X 2000 stage allows us to continue with the development of the technologies necessary for manned flights in Europe and to begin collaborating with Russian companies with a view to having a space shuttle by the beginning of the next century."

Couillard also emphasised the necessity for Europe to acquire autonomy for its manned space flight systems: "The Americans intend to keep their leadership in this field, and do not appear to be prepared to cooperate on the basis of any European prime contractorship. They are not looking to help us with technologies that we do not have. Consequently, it is important that we demonstrate our own capabilities, so that we are taken seriously and that we are on an equal footing when it comes to negotiating a cooperation agreement for the future space shuttle."

The Fight for Life

On 11 June last, a project proposal by the chairman concerning the ESA's long term policy was laid before the delegations of the member states. It summarised the approach, in two stages, studied by Euro-Hermespace, Hermes X 2000 contains the following points:

- a flight model, called SOFT [Sub-Orbital Flight Test], of Hermes has a definitive form, a structure and thermal protection identical to those that were planned originally. However, all the other sub-systems are to be revised downwards, in order to meet the requirement of an automatic vehicle. This flight model will be launched from Kourou, will fly once around the earth and return to the airport at Cayenne. Philippe Couillard, when speaking at the ILA '92 press conference, added that "this demonstrator will be used again and fitted out for manned flights in 2004-2005."

- a test model, known as ALT [Approach and Landing Tests] is equipped with avionics that resemble those used in an aircraft and will be used for approach and landing tests with a pilot on board.

- if ground installations are not available, they will have to be set up for the test and integration of the space shuttle and its subsystems, for its launch, its flight control and landing.

The main phases for the Hermes programme during the 90s will likely be:

- the review of the preliminary design, during the second half of 1993;

- the critical definition review, during the second half of 1997;

- the approach and landing tests in 1999;

- the launch of Hermes X 2000 for demonstration of an orbital flight, during the second half of the year 2000.

The cost of the Hermes X 2000 project, as laid out in the ESA document is put at 3,160 MAU (million accounting units, under 1991 economic conditions) over the period 1993-2001. The proposal deferred in March 1991 by Euro-Hermespace estimated the cost of completing the first phase at 3,952 MAU. Thus, between March and June, the ESA persuaded the industrialists involved to downwardly revise the cost price of Hermes X 2000. Philippe Couillard talked about a reduction of almost half the expenditure originally-planned in the Munich proposal for the Hermes programme. Between 1991 and the year 2000, the earlier plans called for 6,000 MAUs to be spent. "We must do everything possible to keep the countries in the programme and hope that German participation does not fall below 20 percent. The industries cannot do any more to trim down Hermes in order to reduce technological investments still further."

Without further ado, the ESA department of Space Transportation Systems (led by Jorg Feustel-Buechl) has started studies with companies in the Commonwealth of Independent States (CIS). The initial intention is to assess the potential of Russian companies and the possibilities of a close cooperation. This idea is very attractive to Germany, as it means saving time and money in order to produce the ambitious "Long Term Programme" for Europe in space. It remains to be seen how

the Americans will react to this intensification of links between East and West, as they are partners with the Europeans for the International Space Station Freedom. Moreover, in spite of the dismantling of the Iron Curtain, COCOM's strict rules (which control the transfer of technology) have not in fact disappeared yet. To what extent will this desire to exploit the know-how of the former USSR fit in with the safeguard of European industrial skills and highly-qualified personnel?

ESA Assesses Future of Columbus

92WS0807G Brussels *EUROPEAN AVIANEWS*
in English Jul-Aug 92 pp 40-41

[Article by Theo Pirard: "Berlin Discusses Eurocolumbus"]

[Text] The recent latest edition of ILA '92 focused on Christopher Columbus and the "New World" represented by Russia.

Europe is interested in using the space environment for life sciences, materials and fluids work. Moreover, it has to guarantee its presence in all aspects of space exploration, including the operation of orbital infrastructures, the improvement of man's work over long periods and the preparation of preliminary flights around and to the surface of the moon. As the ESA has emphasised, it is a question of "establishing a global and coherent strategy so that Europe can become—by the beginning of the next century—one of the main partners in the future exploration of space by man." The difficulty faced by the ESA is that it must cope with serious budget constraints.

The objective of the Columbus programme is to provide Europeans with a long term infrastructure for technological activities around the earth by the year 2000. The ESA's chairman has proposed a long term programme which calls for Columbus preliminary flights. This was to have included three missions: Eureka 2 and Eureka 3, as well as Spacelab E1 over the period 1995-98. In order to reduce the estimated cost of this phase for precursor flights from 394 MAU (million accounting units) to 280 MAU (1991-92 rate), there are now proposals for a programme that includes a Spacelab mission in 1996 and a Eureka mission in 1997-98. This analysis does not take into account the extra costs linked to the interruption of the Eureka and Spacelab missions; this is based on free launch and recovery of the platform by NASA.

When it comes to Columbus, the ESA no longer mentions the Attached Mobile, a laboratory to be installed on the International Space Station Freedom. The Polar Platform which will use the improved SPOT platform (developed as part of the French Helios military programme) is now part of Earth Observation Programme with POEM (Polar-Orbit Earth Mission); the ESA envisages two types of mission in polar orbit; one known as Envisat for the development of preoperational instruments for the study of the environment; the other is called METEOP for routine operational observations, intended for meteorological forecasting. Envisat 1

should carry an advanced technology SAR [Synthetic Aperture Radar] in 1998 to follow up the two microwave remote sensing ERS satellites. METEOP 1 is scheduled for launch in the year 2000, with meteorological instruments for the Eumetsat organisation.

The current date planned for the positioning of the Attached Module on the International Space Station Freedom is around the last quarter of 1999. The planning calls for a review at the end of 1998 of the definitive equipment to be used, for its sending to the United States. This European Space Laboratory, which will take over from Spacelab, consists of a pressurised cylindrical module and an exterior observation platform. The development of the Attached Module represents a budget of 2,666 MAU between 1993 and the year 2000. Initially, the Columbus Programme considered launching a Free-Flying Laboratory or autonomous pressurized module—equipped with a resource module—for the year 2004, using an Ariane 5 to place it in orbit. However, because of budget constraints, this part is presently on ice.

Though the Columbus programme is dramatically decreasing in size, industrialists are aware of the technological stakes for its realisation and operation. The development of the Attached Module was begun in April 1992. The continuation of work should be confirmed at the forthcoming ESA Council, at the ministerial level; this meeting is planned for 9 and 10 November next in Genade.

On 17 June last, Eurocolumbus Raumfahrtgesellschaft GmbH was created in Berlin under German law. This company is responsible, on behalf of the ESA, for the space segment of Columbus for manned missions in space. The founding shareholders of Eurocolumbus are DASA (ERNO Raumfahrttechnik or Orbital Infrastructure Division) with 60 percent, and Alenia Spazio with 40 percent. It is expected that Matra Marconi Space will later become a 15.5 percent shareholder. Its headquarters are in Bremen, but the company also has offices in Turin, where the Attached Module will be integrated. Some 150 persons will be employed by Eurocolumbus. Professor Ernesto Vallerani, president of Alenia Spazio, is the Chairman of the Supervisory Board for the first year. This board will also be made up of representatives of manufacturers from smaller countries, from Alcatel Bell Telephone (Belgium) and SENER (Spain).

Eurocolumbus is to take into account the opening of the East, which was discussed at the Munich ESA Council last November. Its main shareholder, DASA, took advantage of ILA '92 to propose a new strategic approach for the European space programme. This approach, known as Euro-GUS (GUS is the German equivalent of CIS), encourages cooperation between the ESA and Russia to produce and operate a permanent space station. This station, would replace the Columbus Free-Flying Laboratory by 2005, and would combine parts of Columbus with Mir modules. It would be visited by a shuttle like Hermes (which would replace the Soyuz

vessels) and receive supplies by Progress rockets. Germany believes this Euro-GUS project should be the first step towards a "global cooperation" in space.

The German proposal, which has been put forward by Werner Heinzmann, Director of the Space Systems Group at DASA, is at pains to stress that "by utilising the potential of the CIS, Europe could reach the targets it set itself at the ESA Council in The Hague, with a low level of technological risk and low development costs." The proposal was supported at the ESA by France and Italy. It requires the allocation every year of a special fund from the European Community, worth a total DM200 million (ECU97.6). Germany would contribute 30 percent, which would be spent on space activities in the CIS. This breaks down into DM100 million to maintain the space capabilities of the erstwhile Soviet Union, and DM100 million to cover projects in cooperation with the institutions and industries in the Commonwealth of Independent States, particularly in Russia.

European Students Design Remote Sensing Satellite

92WS0830A Paris AFP SCIENCES in French 3 Sep 92 p 8

[Unsigned article: "Scientific Satellite Designed by European Students"]

[Text] Paris—A communique from the European Space Agency (ESA) announces that an earth-observation satellite has been designed by 20 technical sciences students from 10 European countries, from Portugal to Poland, as part of a "workshop" organized with support from the ESA.

This two-week meeting was initiated by the European Association of Aeronautics and Astronautics Students (EUROAVIA) and conducted on 3-14 August at the European Center for Space Research and Technology (ESTEC) in Noordwijk, the Netherlands, with the objective of providing the students with an intensive practical training toward the completion of their university studies.

It was focused on the design of a scientific satellite, named Ecowatcher, that could complement ESA's future polar orbit mission, POEM-1. According to the communique, at the end of the workshop, the students together with specialists from ESA/ESTEC and the aerospace industry, reached the preliminary design stage. With its main instrument, a sweeping absorption spectrometer with image gathering for atmospheric cartography, the satellite could monitor various atmospheric processes from its 41° orbit.

The data it would collect on trace gases in the lower layers of the atmosphere (troposphere and stratosphere), could help scientists better understand the atmospheric chemistry above the tropical and subtropical regions that determine the planet's climate.

Dassault To Unveil Long-Range Falcon

92WS0832A Paris AFP SCIENCES in French 10 Sep 92 p 17

[Text] Farnborough—Dassault Aviation will present a plan for a very long-haul carrier plane able to cross the Pacific at the International Business Aviation Show (NBAA) in Dallas, said Jean Rosanvallon, the French manufacturer's director of civilian planes on 9 September.

Mr. Rosanvallon pointed out at the Farnborough Aeronautics Show, however, that the company had no intention of immediately launching a program to counter Canadair's Global Express or the American Gulfstream V program, which was kicked off last week with the backing of enginemakers BMW and Rolls Royce.

FLIGHT magazine reports that the future plane may be dubbed the Falcon 9000 and may carry 20 passengers from the United States to Japan. But Mr. Rosanvallon cautiously points out that there are several financial obstacles to such a program.

Dassault is wondering how it would raise the investment money—at least 5 billion French francs [Fr]—needed to build a plane with an operating range of over 11,200 km, and how big the market would be. The plane would probably be a trijet like the Falcon 900. The company will first have to find one or two partners and verify the number of customers likely to buy a plane costing over Fr175 million.

According to Mr. Rosanvallon, the potential top-of-the-line market (Falcon 900, Gulfstream IV, Challenger), where planes sell for Fr125 million each, does not exceed 400. And only a fraction of those customers would be interested in a trans-Pacific airplane.

AUTOMOTIVE INDUSTRY

Daimler-Benz Develops Robot-Steered Vehicle

92WS0827B Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 9 Sep 92 p 8

[Article by K.T.: "Robot Vehicle Without Remote Control; Daimler-Benz Develops Combinable Functional Components"]

[Text] Munich—German Aerospace has presented an unmanned cross-country vehicle at the Pfullendorf military training area that itself seeks out a given route across country, that is, a vehicle that is not remote-controlled. Away from streets, the vehicle recognized obstacles such as bushes, trees, and ditches with its sensors on the several-kilometer-long course and safely circumnavigated them. This concludes the first part of the experimental robotics program that has been in progress since November 1988. The goal is to develop and test the basic

functions of such systems and in particular components that can be fitted together into specific systems.

The functional component, "autonomous locomotion," consists of the vehicle navigation system (FNA), the optical tracker, a television camera, and the navigation computer. With it the cross-country vehicle can cover given stretches, be sent in a desired direction, or driven to target points. With the laser radar developed at Dornier, the functional component, "avoid obstacle," makes sweeps in front of the vehicle within a range of up to 40 meters and passes the values on to the process control computer to calculate the detour [required to avoid the obstacle].

For the functional component, "detection," there are six small cameras with an angle of vision of 60 degrees for panoramic observation, two telecameras that can be panned, a laser rangefinder, and a directional microphone. All of these are mounted on the top of the vehicle and they report movements, anything out of the ordinary, and sounds in the vicinity to the control point by radio.

Using the vehicle to protect soldiers during mine detection and in chemically or biologically contaminated areas is of interest to the military. In civilian applications one can imagine the vehicle on construction sites, in agriculture (in heavy field and plantation chores, for example), and for improvement of the environment involving hazardous chemical waste, at hazardous waste dumps, and in cases of catastrophe.

French Car Makers Struggle With New Fuel Consumption Limits

*92WS0828A Paris L'USINE NOUVELLE in French
10 Sep 92 pp 24-26*

[Article by Oliver Lauvige: "20 Km To the Liter: A New Headache for Automakers"; first paragraph is L'USINE NOUVELLE introduction]

[Text] Accustomed to saving energy, car companies will now have to redouble their R&D efforts to meet both customer demand and the pressure of environmental protectionists.

After tigers and horses, automakers are now going to have to put a camel in their tanks. By setting average automobile consumption in 2005 at 5 liters per 100 kilometers, the German and French environmental ministers are slapping another restriction on manufacturers, whose unanimous response is "It will be tough, very tough!" On the other hand, the public authorities' goal is simply one step ahead of the firms' own research. Ever since 1974 and the first oil shock, the average fuel consumption of French automobiles has fallen from 9 to 7 liters per 100, pushed by the need for energy savings and the interest of the consumer. Achieving 5 liters in 13 years to satisfy today's environmental voters implies a substantial research and development effort.

In January 1990, for instance, the PSA (Peugeot) group launched a program that it described as extremely ambitious. The project will cost 2.5 billion French francs [Fr] over seven years, and upon completion will have to bring down the fuel consumption of all Peugeot's vehicles to no more than 6 liters per 100 km by the year 2000. Manufacturers are caught in the formidable contradictions that are sometimes imposed by environmental protectionists themselves: For instance, limiting pollution from exhaust fumes, they explain, results in a rise in fuel consumption. "If we want to meet the goals of the minister of the environment, all of our plans still on paper or in engineers' heads will have to be implemented without delay," confides Jean Malphettes, the director of "engine" studies at Renault. "Because the vehicles we dream up today will be in full use in 2005." That means that, starting now, manufacturers will have to use every trick in the book to squeeze all they can from the tiniest drop of fuel.

Their first focus will be on making cars lighter. Since 1991 Renault has teamed up with six other manufacturing companies in a EUREKA project dubbed MOSAIC [Optimized Materials for Innovative Automobile Design] that aims to shed those extra kilos. "We are looking for a cost-free way to lighten vehicles that will not raise their price," says Henri Mathiolon, the program's coordinator.

It is also possible to make use of aerodynamic principles, as General Motors did in the Ultralite car it unveiled at the Detroit show on 6 January 1992. With its ground-skimming nose, high-speed raised hind carriage, and 70 kilos of heft, the car has a Cx of only 0.192. Four horsepower are enough to propel it 88 km/hour, compared to the 15 that are needed for a conventional sedan. Its fuel consumption is only 2.7 liters per 100 km.

In fact, the current market trend is to make heavier, quieter, more comfortable, and more reliable vehicles. In 10 years, cars have gained 100 kilos and so require more energy to move.

What is more, the drastic emissions standards imposed by the EC for carbon monoxide, unburned hydrocarbons (HC), and nitrogen oxides (No_x) further diminishes the efficiency of engines. The standards force manufacturers to install catalytic converters that increase the specific consumption of each vehicle 5 to 6 percent, due to the charge lost to the converter and the drop in octane index when the lead is removed. Even diesel engines are languishing because of these restrictions, which require new adjustments. According to PSA, the changes in emissions standards should boost average consumption rates by about 10 percent until 1993-1994. The race to make a non-guzzler seems off to a poor start.

The good fairies of fuel economy, unable to play with weight, shape, or harmful emissions, are going to have to look at the engines being designed. They have several options. The first one is to wait! "Even if we do nothing,

the replacement of old models with new, more fuel-efficient ones decreases the fleet's consumption," explains Andre Douaud. As far as Mr. Douaud is concerned, the goal of 5 liters per 100 km must be applied to a country's entire automobile fleet. The rising number of diesel vehicles, which consume 20 percent less fuel, should help push down the average. Updating the entire fleet and replacing it with small diesel cars would make it easier to reach Segolene Royal's goal. Since this is wishful thinking, however, other solutions must be considered, such as using weak mixtures.

Normally the ideal combustion ratio, or stoichiometric ratio, is one kilo of gas per 14.6 kilos of air. In a conventional, so-called strong-mixture engine (stoichiometry ranging between 1/8 and 1/14.6), droplets of gas near the spark plug are kindled by the spark. The heat thus released "ignites" the neighboring droplets and the flame travels to the ends of the cylinder. With a weak mixture (stoichiometry of around 1/22), the droplets are too far apart to ignite one another. Combustion becomes irregular, unstable, and paradoxically incomplete, producing more unburned HCs than a strong mixture. One alternative is to set the gas droplets in motion, so that the inflamed particles can more easily ignite their neighbors.

In early 1987, PSA set out to experiment with weak mixtures using an engine whose code name was Ceres. The company's engineers introduce additional air into the cylinder head near the valve to create air turbulence. This enables them to shift the gas charge a quarter turn when the piston descends, another quarter turn when it comes back up, and a third quarter turn during explosion. The mixture this creates is enough to produce regular combustion, despite an air/gasoline ratio of 1/22. Though the engine is 6 percent less powerful than its "strong" counterpart, it consumes 12 percent less fuel!

But Ceres will never be mass-produced, nipped in the bud by the new pollution-cleanup regulations of 1989. The dictated emissions thresholds can only be achieved through catalysis that can both oxidize HCs and reduce Nox. To do that, engines must operate with a stoichiometric ratio of 1/14.6. So long, 1/22! But engineers are not throwing in the towel: Confident in the future of weak mixtures, they are working to develop a suitable catalyzer. They expect to produce it around the year 2000.

Another option automakers have for putting their vehicles on a diet is the two-stroke engine. Two-strokes are more mechanically efficient. Indeed, they are free of the friction produced by the driving of the transmission chain and valves, and they feature one explosion per full cycle instead of the one in two of their four-stroke counterpart. These qualities enable them to save 15 percent in fuel consumption (20 percent in city driving), and thus the same amount in carbon-gas emissions. Furthermore, their compactness, lightness, and easy installation under the hood make them one of the favorites in the race toward low fuel consumption. In Detroit, General Motors presented a two-stroke engine

that weighs only 130 kilos and whose six cylinders produce horsepower of 200 at 5,600 rpm.

The French are not laggards either. Citroen had plans to industrialize a two-stroke engine as early as 1960. The direct-injection, valveless V4 boasted horsepower of 90 to 110. But excessive manufacturing costs caused it to lose out to a classic four-stroke engine. Today research conducted in collaboration with PSA, the French Petroleum Institute, Renault, and Moteur moderne focuses on a 1,400 cm³ three-cylinder version as powerful as a 1,600 cm³ one.

"I predicted back in 1990 that we would be seeing the first two-stroke vehicles in an automaker's catalogue," says Andre Douaud. "I stand by my prediction!" His assurance is backed by the confidence of Jean Malphettes (Renault). "If we had to introduce a two-stroke engine in our vehicle line, we could do so in two or three years."

Other solutions are being considered for the longer term. Gas turbines, for example, can adapt to different fuels. "There are also electric cars, or hybrid electric/thermal cars, and the famous hydrogen engines," says Jean Malphettes, anticipating the future. "But there is no chance any of the above will help improve the fuel consumption of vehicles in 2005."

As far as an expert like Mr. Malphettes is concerned, the goal of 5 liters per 100 km is not attainable without government help. Initially, through measures to reduce the drastic limits on harmful emissions, which are incompatible with the development of weak-mixture engines. Later, through a system of dissuasive taxes to persuade drivers to trade in the power of the tiger or the spirit of the horse for the sluggishness of the camel.

Boxed Material: The Big Steps in the Race for Efficiency

For 30 years automakers have been perfecting the efficiency of their vehicles.

Step one: improving the permeability of the engine, to facilitate the flow of gases and better empty the cylinders. Exhaust lines and the designs of intake manifolds were improved.

Step two: improving combustion. This was achieved by preheating the fuel before introducing it into the carburetor tank, modifying the design of the combustion chambers, and adopting fuel-injection in the 404 Peugeot in 1962.

Step three: searching for better fuel quality through a charter with the oil industry.

Finally, changes over the last few years have involved decreasing specific engine weights through more compact architecture, the use of aluminum or thin-walled engine blocks, and the replacement of chains with belts.

Graph: A 67-Percent Loss in Energy: How Fuel Calories Break Down in an Internal-Combustion Engine

Internal combustion engines are real atmospheric heaters, with lamentable mechanical efficiency. More than two-thirds of their energy is lost in exhaust, radiator, or friction heat. Their energy breakdown is as follows: net efficiency 33 percent; exhaust 33 percent; cooling 20 percent; friction 14 percent.

Graph: How to Achieve 5 Liters Per 100 Km

To achieve average fuel consumption of 5 liters per 100 km in 2005, automakers will have to implement all the plans that are still on paper or in the heads of engineers without delay. The average fuel consumption of the French fleet is now 7 liters per 100. To reach 5 L/100, the following steps would result in the savings listed:

- Lighten cars and improve their Cx, -0.4 L/100;
- Launch the weak-mixture and two-stroke engines, -0.4 L/100;
- Boost the production of electric cars, -0.3 L/100;
- Make relatively unsophisticated cars, -0.3 L/100;
- Reduce the power of all engines, -0.2 L/100;
- Reduce friction (transmissions, rolling...), -0.2 L/100;
- Eliminate single-occupant vehicles, -0.1 L/100;
- Boost the number and performance of diesel cars, -0.1 L/100.

These combined measures would produce the average consumption of 5 L/100 slated for 2005.

France: 'Green' Diesel Fuels City Buses

92WS0833B Paris AFP SCIENCES in French
10 Sep 92 p 33

[Unattributed article: "Eighteen Grenoble City Buses Run on Diester Fuel"]

[Text] Grenoble/Bordeaux—A complete line of 18 buses, belonging to Grenoble Area Transportation (TAG) has been running on a biofuel based on rapeseed oil, called diester, since 7 September.

Tested by the laboratories of the French Petroleum Institute (IFP) and characterized by the absence of sulfur compounds, the "green diesel" fuel consists of 70 percent diesel oil and 30 percent diester. Renault Industrial Vehicles (RVI) maintained its manufacturer's warranty, and the busses will be the subject of analyses at regular intervals. Frequent tests will check, among other things, the positive effects of diester on the environment.

At Agen (Lot-et-Garonne), the entire 14-bus fleet has been running on a blend of 30 percent diester and 70 percent diesel oil since 7 September, as part of an experiment scheduled to last one year.

The experiment is original in that it involves all the vehicles of a given town, which will make it easier to measure the impact of the "green" fuel on the environment, according to the Aquitaine regional council.

In Aquitaine, 10 busses have been running on diester in Pau (Pyrenees-Atlantiques) since June, using a 50-50 blend of diester and diesel oil; early in October, 10 Bordeaux buses will conduct an experiment using 100 percent diester. The Aquitaine regional council is making a feasibility study in order to launch immediately a rapeseed- and sunflower-growing program that would produce diester by 1994-1995.

BIOTECHNOLOGY**German College of Technology Develops Rape Oil-Based Hydraulic Fluid**

92MI0724 Bonn WISSENSCHAFT WIRTSCHAFT
POLITIK in German 19 Aug 92 p 5

[Text] On behalf of the Federal Ministry of Food, the Aachen College of Technology has developed a rape oil-based hydraulic fluid. The product was created by the Institute of Hydraulic and Pneumatic Drives and Control Systems, and meets higher technical specifications than the vegetable-based hydraulic oils available to date.

"Blue Angel" a Certainty

This has been achieved by using biodegradable additives with a zero or only minor waterway hazard potential. The newly developed hydraulic fluid fully meets all the ecological criteria set out in the bill on the award of the "Blue Angel" environment symbol.

In the past year, around 166,000 tonnes of hydraulic oils have been sold in the Federal Republic of Germany. The hydraulic fluids in current use are based on mineral oil products.

The main reason for the Federal Ministry of Food research assignment was the recognized need to protect soils and waterways from pollutant discharges. The project also defined the additional research requirement for hydraulic fluids made from vegetable oils, which must fulfill even more stringent technical requirements. In the view of the Federal Ministry of Food, the results of the research project and practical trials confirm previous estimates that, in the year 2000, it will be possible to operate up to 10 percent of all hydraulic systems with vegetable-based fluids.

Survey of Biotechnology Research in Germany Described

92WS0804A Duesseldorf HANDELSBLATT in German
9 Sep 92 p B11

[Text]

Financial Commitment of Industry Reflects High Expectations

Research: Fraunhofer Institute Studies German R&D Activities in Biotechnology

In practically all highly industrialized countries, biotechnology is one of the strategic technologies. The current economic importance of biotechnology is, however, still comparatively small. Optimistic market forecasts of the past have not yet come true. Thus, for example, in the pharmaceutical industry, genetically engineered drugs account for 1 percent to 1.5 percent of the global pharmaceutical market, worth about 250 billion German marks [DM].

Previously, little was known about industry spending for R&D in biotechnology. Indirectly, of course, one can infer intensive worldwide R&D efforts based on patent analyses. For example, the total number of patent applications in biotechnology in the European patent office increased almost fivefold in the 1980s. As far as invested funds are concerned, however, one must rely on estimates. It is calculated that industry in the U.S. finances about 40 percent of R&D spending in biotechnology.

In order to obtain more detailed information on R&D spending and structures in German industry, a survey of industrial R&D activities in biotechnology was recently carried out by the Fraunhofer Institute for Systems Engineering and Innovation Research (ISI), Karlsruhe, with funding by the BMFT [Federal Ministry for Research and Technology].

Predominantly Small and Medium-Sized Businesses Active

This survey was based on a broad definition of biotechnology which sees biotechnology as the application or utilization of living organisms or parts thereof, first for the production or modification or degradation of substances, secondly for the alteration of organisms, thirdly for services.

The most important areas for the application of biotechnology are medicine/pharmaceuticals, chemistry, environment, nutrition, agriculture, renewable resources, and energy. Also of importance are the interdisciplinary activities of methods development, process engineering, enzyme engineering, analysis and quality control, safety research, and technology assessment as well as computer science/EDP [electronic data processing].

R&D of Central Importance for Many Companies

In the Federal Republic of Germany, a total of about 400 small and medium-sized businesses as well as 30 large companies are active in biotechnology; their R&D activities lie primarily in the areas of environment, medicine/pharmaceuticals, methods development, and process engineering. At most of these companies, fewer than 100 employees are working in the area of biotechnology. This means that even in the large companies, biotechnology is carried out with comparatively little personnel capacity, comparable to that in a correspondingly small company.

This structure is also reflected in the sales figures. Most companies have annual sales of less than DM50 million. In the companies surveyed, which earn their money with biotechnology, R&D plays a central role. On the average, R&D spending amounts to 15 percent to 17 percent of the sales in the area of biotechnology. In comparison to the economy as a whole, with an R&D quota of 3.3 percent, or to the chemical industry, with a quota of 6.4 percent, biotechnology is extremely research-intensive. Biotechnology is thus definitely among the state-of-the-art technologies, which include areas of technology with R&D quotas greater than 8.5 percent.

R&D is not only pursued within the companies. A definite percentage of the sales, specifically between 1 percent and 3 percent, is spent for external R&D. The most important cooperation partners are the universities. Together with the fact that the Max Planck Institutes function quite often as cooperation partners, this indicates that it is primarily basic projects which are carried out cooperatively.

Industrial spending for R&D in biotechnology is estimated to be about DM1.1 billion per year in the Federal Republic. Together with public expenditures, the total spending for R&D in biotechnology in the Federal Republic adds up to about DM1.5 billion per year. This corresponds to 3.5 percent of total R&D expenditures in the Federal Republic. The division of R&D financing in biotechnology between government (one-third) and industry (two-thirds) corresponds approximately to the average from other areas of technology. The relatively strong commitment of industry to financing R&D in biotechnology indicates that there are high hopes for future development here.

Main Applications Lie in the Area of Medicine/Pharmaceuticals

Most of industrial R&D spending in biotechnology goes to the area of medicine/pharmaceuticals. It is worth noting that large and small companies have different areas of emphasis for their R&D activities. Medicine/pharmaceuticals clearly dominates among the large companies. Smaller companies, however, spend the most for R&D in agriculture. It is remarkable that the greatest share of R&D spending in environmental technology comes from small and medium-sized businesses.

Altogether, the survey of industrial R&D activities in biotechnology shows that, at present, biotechnology is in a dynamic phase, as is typical for the beginning of a diffusion cycle. Research intensity is high, interdisciplinary activities play an important role, cooperation with universities in the area of basic research is important. As ISI's comparative studies in other science-based areas of technology have shown, basic research and its continuous transformation into applied R&D is essential for opening up new areas of application, even in advanced stages of technology development.

However, the many small and medium-sized businesses have only limited possibilities for financing appropriate

basic R&D projects. Consequently, public funding of research will continue to play a central role in biotechnology. A comparison with the U.S. in this matter is also valuable. Factors which might be responsible for the currently dominant position of the U.S. in biotechnology are not only the availability of venture capital or more favorable regulatory conditions, but also the massive governmental support of basic research, which is to be consolidated at a high level or further increased in accordance with current budgetary planning.

Against this background, the question arises of whether the planned reduction of R&D spending for biotechnology in the BMFT's current draft budget does justice to the importance of biotechnology as a strategic technology of the 21st century.

Footnote

Dr. Thomas Reiss, head of the Biotechnology Group, Fraunhofer-Institut fuer Systemtechnik und Innovationsforschung [Fraunhofer Institute for Systems Engineering and Innovation Research], Karlsruhe.

Scottish Firm Uses Sheep to Produce Medicine

92WS0804C Duesseldorf *HANDELSBLATT* in German 9 Sep 92 p B11

[Text]

Drugs Obtained From Sheep Milk

Transgenic Animals: Substitute for Expensive Bioreactors

"Pharming," pharmaceutical farming, is what the Angloamericans call the production of pharmaceutical agents in animals or plants. Foreign genes are transferred into sheep, pigs or potatoes with molecular biological methods so that they yield substances which are not otherwise produced on the farm.

"Recombinant AAT (alpha-1-antitrypsin) can be obtained from a liter of the milk of transgenic sheep almost 12 times more economically than from a liter of conventional cell culture," estimates Alan Colman of Pharmaceutical Proteins Ltd. (PPL) in Edinburgh, Scotland. AAT is a drug used to treat emphysema, a dangerous accumulation of air in tissues and organs. The German pharmaceutical company Bayer also sees a market for AAT and has therefore invested money in PPL's projects. Until now, AAT has been obtained from blood plasma as well as from cell cultures through fermentation; there is a demand for several tons per year.

It is difficult to predict when sheep farms will supply AAT in kilogram amounts per year and animal. For one thing, there are licensing procedures to go through; for another, it takes a while until a sheep can give the first milk.

The gene with the instructions for AAT synthesis was injected into artificially fertilized egg cells. An intact copy of the transferred transgene was found in four female and one male sheep (of 112 births). The four

pharma-sheep gave birth to transgenic and non-transgenic lambs. According to PPL's measurements, the ewes' maternal milk contained more than 30 g AAT per liter in some cases. Separation resulted in a purity of over 95 percent, and biological activity corresponded to that of material obtained from human blood plasma.

A further example of pharming is the production of t-PA [tissue plasminogen activator] from goat's milk. The drug can dissolve blood clots which cause cardiac infarction. The best animals are cows, which can be milked all year round. However, breeding transgenic specimens takes the longest with them.

To a large extent, familiar agricultural methods can be used for harvesting pharming products, which contributes to profitability. Agrobiotechnological methods are modular; to increase profits, one more field is planted or additional animals are incorporated into the herd.

The potato is also being discussed for general "molecular farming," the production of non-pharmaceutical substances. Scientists at the Berlin Institute for Biogenetic Research have altered this member of the Solanaceae to such an extent that an especially uniform starch is formed in the tubers. In contrast to pharming, it is not protein which is accumulated, but rather a secondary product, namely the polymeric carbohydrate starch.

With certain procedures this starch can be used like a thermoplastic synthetic material for containers and films which, after use, can be degraded biologically in landfills. Preliminary field trials are planned for the Rostock area in 1993 in order to test whether the altered genes deliver in the open what they promised in the greenhouse.

Researchers from Calgene, California, succeeded in inducing potatoes to produce cyclodextrins, cyclic carbohydrates, using genetic engineering. Cyclodextrins are of importance in the formation of new inclusion compounds, by means of which "guests" can be protected or isolated in the ring. However, these transgenic potatoes have not left the laboratory yet either.

Problems, Prospects of Eastern German Biotechnical Research

92WS0821B Berlin *ING DIGEST* in German Sep 92 pp 45-46

[Article by Dr. Rainer Voss: "Opportunities for Research Without Production?"]

[Text] Nearly three-fourths of the eastern German industrial enterprises have halted their biotechnology production since the beginning of 1991. More than 80 percent of the industrial research has been liquidated. But the greater part of the nonacademic biotechnical research was given a positive evaluation. Are there new opportunities here? Results of studies say so.

The FRG is determining a growing gap in the dynamic research and innovative field of biotechnology between

Germany and the leading United States. Initial fears by the international competition that the merger of the two German potentials could lead to Germany taking a dominant position are scarcely heard any more. The upheaval of eastern German biotechnology was too radical for that, and integration of the new structures into the overall German research landscape is—as so many other things—taking longer than expected.

The fermentation complex in Schwedt for microbial production of unicellular protein based on petroleum distillates, built at a cost of billions and only in production for a few years, was closed down and demolition began in 1991. This process involves an innovation developed internationally in the late 1960s, which was soon abandoned again because it was in no way able to compete with protein extraction from natural raw materials, primarily soybeans. In the GDR one stayed with it in order, among other things, to repay imports and in the hopes for the powerful USSR market, and construction on the facility was later begun. With the entry of the market economy it lost all value. Out of 750 researchers, technicians and plant drivers, only 50 remained—for the disassembly.

Pharmawerk Neubrandenburg declared bankruptcy in 1991. Built as late as the second half of the 1980s for more than 1.5 billion German marks [DM], it has never sold a product. The principal purpose was biotechnical production of source materials for penicillin, a product which had been available on the international market for more than 40 years. The "economic" reason for this investment was similar to the one at Schwedt.

Many Manufacturers Managed

Faced with the disappearing innovative force, the attempt to realize modern biotechnology methods based on genetic engineering in outdated production facilities, as practiced in the former PROWIKO company in Schoenebeck, also failed. The abrupt confrontation with the world market and the simultaneous breaking away of the CEMA market led to the collapse of a large part of the biotechnology production. Nearly 75 percent of the eastern German companies halted their activities in this field.

This was what the reduction of the industrial research, which was tied to the relatively low level of production, had to deal with. The industrial sector research centers were also hard hit. Thus, the Biotechnik GmbH Berlin research center (formerly GERMED Combine Dresden) lost 98 percent of its contracts after the currency union. Thanks to many activities of its own and the BMFT's [Federal Ministry for Research and Technology] support of 19 projects, it has survived so far.

But all in all the industrial or applied biotechnology research potential in eastern Germany has been reduced to 10-15 percent. The fact that the powerful Biotec research team at Chemie AG Bitterfeld was cut from 120 to 15 employees in the employment and competency training organization should give food for thought in view of the environmental problems in Saxony-Anhalt.

Due to the elimination of industrial financing, academic, university and state institutes were forced to assure their existence through new projects, means of support or changes in profile. According to the unification agreement, the elimination of the institutes of the former Academy of Sciences and the agricultural sciences also began at the same time. Beginning in the fall of 1990 expert groups of the Science Council also evaluated the biotechnology research groups, which presented themselves for judgment with partly new, demanding projects: More devotion to basic research and to process development—such as in the fields of plant biology, renewable raw materials, genetic engineering and environmental technology—was characteristic of this.

As a result, many of these research groups also had their high scientific level certified and it was recommended that their work in the newly forming or restructuring research facilities should continue. Most research sites were thus retained. But this so far unique evaluation process harbors many problems. Consequently, although 78 percent of these research units at the academies got a positive recommendation, only about 50 percent of the existing scientific positions were connected with it. During the implementation they were, to some extent, further reduced, and even powerful scientists were excluded. Given this development, the demand to expand the agreed cutback in positions at the German research facilities by 10 percent to include even those institutes in the east which are being newly built is incomprehensible.

Research is still going on in this field at nearly 60 institutions—among them two major research centers, eight blue-list institutes, 10 universities and four polytechnic colleges, nine federal facilities and laender institutions and research corporations. About 10 companies include biotechnology products, processes and services in their profile. Primarily in the broad research spectrum there are real opportunities for specialized development. There is no alternative to this. Without research and innovation the regional disparities and weaknesses of the new laender cannot be overcome.

In view of the lack of an industrial base, maintaining the powerful biotechnical capacity is of crucial importance. This is the case at the Hans Knoell Institute for Natural Material Research in Jena, at Halle University and Kothen Technical College. Unfortunately, the technical college at Chemie AG Bitterfeld is completely shut down at present. But the experimental and pilot productions which are possible at these technical colleges are a decisive precondition for the practical evidence of eastern German biotechnical research. But they cannot replace the missing industrial base.

Biotechnology companies in particular are suitable, thanks to the integrating cross-section effects of their methods and products, for becoming the starting point for new networks between research, production, services and application. Unfortunately, there are few examples of companies which could grow into such a role: Mytron GmbH in Heiligenstadt, Elwana GmbH in Neustadt-Glewe, the Institute for Grain Processing GmbH in Bergholz-Rehbruecke, Bio-Ingenieurtechnik GmbH in Grimma and the Jena branch of

UTEC Thyssen GmbH are among them. If entire lines of innovation can become established there, it would be of strategic significance for the development of the new laender.

Regional Evaluation of Technological Consequences

In the research policy concepts of the old laender, biotechnology has for years been one of the fields particularly worthy of support, for example in Baden-Wuerttemberg, North Rhine-Westphalia and Schleswig-Holstein—laender with varying regional conditions and structural problems. For this reason the new laender must also examine, develop and utilize the existing and anticipated potential of various fields of technology in order to solve their regional development problems.

Suitable for this are, for example, regionally oriented evaluations of technological results. Based on an analysis of the goals and conditions of the region, they should evaluate the potentially positive as well as undesirable effects of more integration of a certain technological field into the structural change in the region. At the same time it is important—on the basis of the existing facts—to evaluate the regional preconditions which must be created, in order to be able to realize a stronger involvement in a technological field as well as with the desired effect. Such preliminary work is under way regarding biotechnology in the land of Brandenburg.

Facilities Relevant to Biotechnology in the New Laender

RESEARCH	Spring 1990	Spring 1992
Mecklenburg-West Pomerania	6	5
East Berlin	13	8
Brandenburg	11	10
Saxony-Anhalt	16	15
Saxony	9	5
Thuringia	8	8
PRODUCTION	3	1
Mecklenburg-West Pomerania	3	1
East Berlin	2	2
Brandenburg	3	2
Saxony-Anhalt	12	1
Saxony	9	1
Thuringia	3	3

German Biotech Companies Said To Need Strategic Alliances Abroad

92WS0827A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 7 Sep 92 p 10

[Article by G.M.: "German Biotech Industry Collapsing; Biotech Companies Must Seek Strategic Reinforcement Abroad"]

[Text] Frankfurt—Management consultant Dr. Norbert Rau, the managing director of the Raucon Company in Dielheim, fears that, as far as the biotech industry is concerned, Germany's standing can, practically speaking, no longer be preserved. He said that positive development had reached its peak in 1987. But that it came to an end after the fourth amendment to the Federal Air Pollution Act. "From that moment on, there were practically no longer any investments and the Biotechnology Law has to this day produced no change in the situation," Rau said, regretfully.

He said that the periphery of suppliers, especially in the pharmaceutical industry sector, little noticed by the public, has almost collapsed. The journal CHEMISCHE INDUSTRIE writes in its current issue (No. 9, pp 16-18) that, if the Raucon Company had been literally overwhelmed with orders from the mechanical engineering sector between 1985 and 1987, these manufacturers would by now have completely withdrawn from the field of biotechnology.

He said that the reason for this is the combined effect of several factors. Thus, in the fields of basic and applied research, right from the start, the critical mass that is essential to economic success and which already exists in, for example, the Anglo-Saxon countries was lacking. In Rau's opinion, the politicians were simply overtaxed by the complex interrelations in the field of molecular biology. They adopted the views of the opponents of genetic engineering.

Laws and administrative regulations were enacted that were simply not practicable for firms that engage in international operations. These facts have only now come to the attention of the world of politics. Rau advises the companies involved to conduct detailed analyses of their development and production standing with respect to the growing international competition situation: "Companies that are now engaged in biotechnology have no choice but to acquire strategic reinforcement abroad."

COMPUTERS

Germany: Software Refurbishing Offers Cost Advantages Over New Software Development

92WS0786B Duesseldorf VDI NACHRICHTEN
in German 31 Jul 92 p 11

[Text]

Software Refurbishers Spruce Up Old Programs

New Software Development Can Be the Worse Route

Existing Value in Company-Specific Solutions is Preserved

Old computer programs, just like historic buildings, usually have high value in ideas and development costs. Keeping them often makes more sense than replacing them with new programs. Software refurbishers thus have a broad field of activity.

Computers are generally written off in four or five years and replaced by new more powerful machines. The software, however, often outlives generations of computers, especially if it was developed according to company-specific needs. It is therefore necessary to keep transferring it to new hardware. Old computer programs thus accumulate among the users.

"Large amounts of software were produced with ingenious ideas, but without norms and standards," says Gerd M. Henselmann, describing the problem of these old programs, because in the pioneering period "creativity" was clearly foremost, method was of secondary importance. "Our efforts with the care and preservation of these unique specimens are correspondingly great" says the managing member of the Cologne management consulting firm Collogia, which is involved in the broad area of software refurbishing with transfer and re-engineering.

Henselmann describes how serious a burden the old programs are and how much time and money they cost based on his own experience with his clients: "Some companies use up to 80 percent of their software capacity for the maintenance of existing systems. And the tendency is increasing." The bulk of the work is in the continued development of existing computer programs, not in debugging. This is terribly inefficient for the programmers. Since many of the software writers have left the company and the underlying concepts are no longer known, according to Henselmann "most of the time is wasted with incorporation into the existing software environment."

Saving what exists instead of replacing it by writing new programs is the starting point for the activities of Collogia. Re-engineering should lead to preserving as much of the value present in the software system as possible—ideas and development costs—and to making it fit for the future through conversion to new technologies.

The individual measures begin after analysis and evaluation: often the entire system, but sometimes only individual components need to be renovated. In one case the specialists from Cologne were able to greatly improve the running time of a databank application, describes Henselmann, because for optimization they used their own "compose" databank, in which over 1,000 performance criteria of commercial relational databank systems are stored.

The refurbishers also tackle maintenance problems with the promising methods of CASE technology, computer-aided software engineering. Here, of course, systematic methods appropriate for engineering must be combined with the creative thinking of earlier software artists as their old programs are transferred into a CASE environment. This can be achieved with reverse engineering, a reconstruction method which ferrets out the design and structures from the source code. After storage in the repository and some manual follow-up work, the way is open for the further development of the software on the CASE level.

In his conversations with customers and potential clients, Henselmann has discovered to his surprise that in only about "half of the cases analyzed does the old software date from the 1970s." It is still in use and has strategic importance. In contrast, the other programs in need of refurbishing are from the second half of the 1980s, although they are based on newer technologies. They were developed either without a basic design concept or with a totally inadequate one. Even with new software projects, especially if they are complex, there are often no clean and transparent concepts. An error unrecognized by many programmers precisely because of the modern development aids.

It is scarcely possible to make an exact ranking of the user industries with the greatest need for refurbishing. But among Collogia's clients are large firms from the areas of chemistry, electrical engineering, and plant engineering and construction as well as classical hardware manufacturers. "Large industrial companies attack the problem of old software quickly," observes Henselmann. "If they cannot solve the adaptation, they switch over to the computer system of another manufacturer and its accompanying computer programs."

Henselmann sees the largest area in banking, insurance, and service companies. They are among the oldest DP [data processing] users, have very demanding solutions, and must refurbish them because they base their business on them. Surprisingly, even software companies which provide products themselves and want to transfer to new computer systems seek the help of external consultants.

Anyone who faces the question of refurbishing or buying new software should first investigate whether and to what degree the existing programs can be replaced by standard solutions available on the market. Economic considerations come next. Refurbishing is preferable if it

amounts to one third of the cost for developing new software, advises Henselmann. One could get by more cheaply and would not need to be concerned about new software risks, introduction, and employee training.

West German Software Companies Advice to Target European Market

92WS0796A Duesseldorf VDI NACHRICHTEN
in German 21 Aug 92 p 14

[Text] The market research firm IDC Deutschland, the Federal Alliance for Office and Information Technologies (BVB) and the League of Business Advisors (BDU) have undertaken an initiative to provide German software and systems companies with information and assistance which will strengthen them in the face of competition from other countries. According to statements by the three, German businesses currently have a service market share of approximately 65 percent, but this number is falling.

According to Thomas kW. Tiefenbrunner, chief executive of IDC Deutschland, "It is true that the FRG is the largest market in Europe for software and services, with a 21 percent share of the European market. But it is often overlooked that already a good third of sales in Germany is flowing into the pockets of foreign countries." Tiefenbrunner estimates the total European market for software and services at approximately \$60 billion.

According to IDC, the German software scene is dominated primarily by mid-level providers. They say that only four German software and service companies employ more than 1,000 workers, and a further 22 companies employ more than 200 workers. The majority of the total of the more than 4,500 German suppliers is chiefly active in specific niches. Most companies have few products of their own and rarely have long-term projects. Capital endowment is often low. Tiefenbrunner also sees this as the basis for the strong focus on the home market: "There are only a few German data processing suppliers who play a European role, much less a global one. Our initiative is intended to help the companies in opening themselves to the existing internal European market."

The first activity planned is the "German Software Fair" (16/17 September in Frankfurt a.M.) with the motto "Software Industry in Transition." On the program are topics like client/server computing, object orientation, networks as the basis for modern information processing, and new copyright as an opportunity for the software business. Human resources in the software industry and the promotion of the software industry following the example of North Rhenish Westphalia and the structure and internal dynamics of the most up-to-date social systems are to be discussed.

DEFENSE R&D

Europatrol To Create Maritime Patrol Plane

92WS0830B Paris AFP SCIENCES in French 3 Sep 92
p 10

[Unsigned article: "European Consortium to Develop Maritime Patrol Plane"]

[Text] Paris—Six European aircraft manufacturers announced on 1 September that they have created a European industrial consortium called Europatrol for the joint development of the 21st century future maritime patrol plane.

At first, Alenia (Italy), British Aerospace (United Kingdom), CASA (Spain), Dassault Aviation (France), Deutsche Aerospace (Germany), and Fokker (the Netherlands), will contact their national governments to establish a project that will become part of the Independent European Programs Group (GEIP).

The communique from the six companies indicates that this first stage will make it possible to define a plane and a joint task system, and to synchronize the schedules of the various European users. In the field of maritime patrol planes, Dassault, Deutsche Aerospace, Alenia, and Fokker have collaborated on the Atlantic planes, British Aerospace has built Nimrod, CASA has produced the C 212 and CN 235 planes, and Fokker the Maritime Enforcer MK2.

Sweden's Saab Willing to Collaborate on EFA

92WS0832B Paris AFP SCIENCES in French
10 Sep 92 pp 17-18

[Text] Farnborough—According to the Swedish group Saab, the Swedish manufacturers with whom it has teamed up to produce the Jas 39 Gripen fighter are willing to collaborate with promoters of the European Fighter Aircraft (EFA) to make a joint airplane early in the next century.

But during a conference given 8 September in Farnborough, program official Jan Hammarstrom stressed that Sweden already has a program underway, and that it would continue, with delivery of the first plane to Sweden's army slated for June, 1993. "The delivery of an initial batch of 30 planes to Swedish armed forces will be followed by a second group of 110 scheduled for delivery between 1996 and 2001. The total cost will be 58 billion Swedish crowns" (as many French francs [Fr]).

"It is the third phase that could involve collaboration with other Europeans," added Mr. Hammarstrom, citing Germany's desire to redesign a lighter European fighter plane that would be less costly than the one now being studied by England, Italy, and Spain. "There have not yet been any discussions among manufacturers, but governments have contacted one another."

Swedish defense minister Anders Bjorck confirmed that Sweden was prepared to back Germany's drive to economize by sharing its experience with the Gripen.

ENERGY, ENVIRONMENT

German Institute Develops Alternative to Diesel Engine

92WS0728A Duesseldorf *HANDELSBLATT* in German
23 Jul 92 p 19

[Article by Bernd Genath: "New Motor for Block Heating Power Stations: Oil-Gas Engine/Juelich Research Institute: Clean Alternative to Diesel"; first paragraph is *HANDELSBLATT* introduction]

[Text] 22 Jul (*HANDELSBLATT*)—Since the successful test run of a prototype at the Juelich Research Institute GmbH (KFA [Nuclear Research Facility]), there has been a show of optimism for an efficient alternative to today's diesel principle—more efficient in output, displacement, and pollution reduction. The new variant can best be described as an oil-gas engine: The diesel/air mixture is not prepared in the cylinder in the conventional way but rather the fuel is vaporized outside the cylinder in steam. The injection nozzle then injects the mixture into the precompressed combustion air.

Thus, in comparison with the conventional diesel, totally different starting relationships are present for the subsequent combustion—because the injected oil-gas is composed of approximately two parts steam and one part fuel. In principle, fuel engineers have long known that heating oil/water emulsions guarantee cleaner combustion than burning fuel alone: The small water droplets vaporize faster when heated than does the oil; the vaporizing water particles rip the associated diesel particles apart explosively and atomize them ideally—resulting in good combustion.

The advantages are described as follows in the literature: more complete combustion, less soot formation, lower nitrogen oxides. However, with the conventional diesel engine without external vaporization oil/water emulsion results at best in lower nitrogen oxides, but the efficiency of the engine drops. In contrast, with oil-gas the combustion pluses are best achieved, with the additional bonus of increased engine efficiency. More complete combustion and less soot because of the excellent mixing, because oil molecules are added to the steam molecules upstream of the injection nozzle and thus no liquid droplets, just steam molecules, are shot into the combustion chamber at the speed of sound.

The mixture burns as soon as it is injected into the combustion chamber without any ignition lag and without the otherwise very fertile sooty zones around the fuel droplets. The successful suppression of soot can also be traced to the attack of the water molecules on the fuel

molecules. HO-radicals are produced in this partial decomposition, and it is known that they minimize the formation of soot.

The reasons for the reduced nitrogen oxide output are obvious: NO_x emissions increase with rising combustion temperatures; in contrast, the steam in the oil-gas engine lowers the combustion temperature by 200 to 300°C.

Even the local temperature peaks, which appear in the conventional process in the region of the injection nozzle and on the boundaries of the flame because of incomplete mixing, are absent. These peaks favor nitrogen oxides even in very lean engines with high excess air values. The oil-gas engine eliminates these problems relatively elegantly.

And finally, the improved efficiency of the engine is a result of optimal combustion and of the steam which is present as a coolant during combustion, delivering more energy to the piston in the power stroke and yielding less energy loss.

With regard to excess air: The conventional diesel system operates with lambda numbers 1.5 through 3, i.e., 1.5 to 3 times more parts per volume of air per part fuel are required than are theoretically needed for oxidation. Only at these concentrations are engine builders on the safe side of halfway environmentally sound combustion with tolerable soot formation. Gasoline, with a largely homogeneous mix produced before combustion gets by with significantly less air. For the diesel process this need for more air first means lower efficiency relative to displacement or in other words: low energy content of a highly air-enriched mixture.

Consequently, the performance of a diesel engine is significantly lower than that of a gasoline engine with the same cylinder volume. Attempts to increase the efficiency relative to displacement in the diesel engine led to the exhaust gas turbo-supercharger. This trick is not needed with the oil-gas engine because it gets by with much lower quantities of air anyway, i.e., close to the stoichiometric ratio. This and the improved efficiency increase the mean pressure in the cylinder and thus its output per unit of displacement.

Second: The normal form of the diesel engine is not only large in volume, but also very heavy. This is primarily because of the fact that for ignition of the injected diesel fuel the air heated to this ignition temperature of 600 or 700°C must also be precompressed so that, if possible, the injected fuel vaporizes without any ignition lag. For this the compression ratio must be 15 to about 20, whereas a gasoline engine makes do with 10 to 12. This high compression in turn requires massive construction. Because of the immense load on the engine from the very high combustion pressures up to more than 150 bar, engineers have to provide thicker material everywhere. Thus, according to experience a diesel engine weighs roughly twice as much as an Otto engine.

The higher compression ratio helps efficiency to a certain extent, but the improvement is not linear. It would be ideal if a diesel engine with lower compression but equally high efficiency could be created. Then its weight could be cut. Oil-gas permits this. Ignition occurs at a compression ratio as low as six, and with the completeness which the conventional variant does not obtain until it reaches a compression ratio of more than 15.

Experiments at Juelich revealed the basic capability in the course of the carbon dioxide discussion and in the search for a conventional diesel with reduced pollution. As a side effect, this route also relieves the engine of its stress even with improved efficiency. However, this modification can be obtained only at increased cost. This occurs first in the vaporizer—because the oil-gas principle is an autothermal process, i.e., it can operate without additional outside energy. The calories needed to vaporize the water and the oil are drawn from the exhaust gas via a heat exchanger in the exhaust line.

Second, the engine must be retrofitted for oil-gas injection. Third, it is necessary to use desalinized water, and, fourth, this requires cooling the exhaust for recovery of the condensate. Fifth and last, the actual autothermal process does not start without short-term preheating of the vaporizer. This requires an external heating system for the start phase of 1 or 2 minutes.

The increased cost is offset by the savings for the exhaust gas turbo-supercharger, a soot filter, or an exhaust catalyzer—all expensive components. The researchers at Juelich are no longer discussing basic technical problems. It is now time to hand over the principles developed to a competent engine builder to complete development under industrial conditions. The successes to date have been limited to small engines with single cylinder engines and displacements between 50 and 280 cc, which have in principle pointed the way to the oil-gas injection diesel with environmentally safe and energy saving combustion.

The new technology lends itself—because of the necessary additional components—more specifically to stationary engines, for example, in block heating power stations. Here, there is currently a conversion to gas engines, because the gas engine does not produce soot. The additional service which a diesel engine constantly requires to suppress these pollutants mean that diesel fuel is not exactly the fuel for this modern form for generation of power and electricity. However, this again binds the operator to a supplier, to rates, to a gas line, and the like. The oil-gas process would offer block heating power station operators a completely different system.

German Environmental Research Capability Strengthened

*92MI0740 Bonn BMFT JOURNAL in German
No 4, Aug 92 p 1*

[Text] Nature's capacity to absorb environment-polluting chemicals and waste products is limited. The

ability of various types of ecosystem to cope with pollution and regenerate themselves are now to be determined, the consequences of further environmental modifications highlighted, and scientific principles arrived at for restoring and reshaping them. The Federal Minister of Research and Technology has therefore made ecosystems research a key area for funding. Research will concentrate on typical central European ecosystems (agricultural areas, forests, riverscapes, urban and industrial areas) and—in cooperation with other countries—tropical ecosystems in Brazil and desert areas in Israel.

The ecosystems research undertaken in Germany will be part of an international joint effort seeking to answer questions arising out of man's growing exploitation of the earth and increasing consumption of raw materials: What effect does a modified climate have on ecosystems? What steps must agriculture take to become environment-compatible?

Five excellent ecosystem research centers were founded between 1988 and 1992: the Forest Ecosystems Research Center at Goettingen University, the Kiel Ecosystems Research Project Center, the Bayreuth Institute of Terrestrial Ecosystems Research, the Agricultural Ecosystems Research Association in Munich, and the Leipzig-Halle Environment Research Center (UFZ).

These five centers have now come together in a national research association, to be known as TERN [Terrestrial Ecosystem Research Network], so that they can compare their findings and make them an effective contribution to international cooperation. They are focusing on the following topics:

- the effects of increasing CO₂ concentrations on plants and ecosystems;
- using vegetation to control the energy and water exchange;
- how global changes affect the biogeochemical cycles of carbon, nitrogen, sulfur, and phosphorus;
- land exploitation and trace gas emissions;
- regionalization of ecosystem processes.

This gives Germany an efficient ecosystems research capability of worldwide repute. The Federal Ministry of Research and Technology is spending 90 million German marks in 1992 alone to support both the work of these five centers and ecosystems research in further joint projects.

Research Into Reducing Eastern German Air Pollution Advances

*92MI0741 Bonn BMFT JOURNAL in German
No 4, Aug 92 p 7*

[Text] The atmosphere and environment in the new laender are particularly heavily polluted. The principal cause is the burning of low-grade brown coal. The high sulfur content of this coal led to high SO₂ emissions, the high salt content caused emissions of chlorine, and the

high water content gave rise to sulfuric acid precipitation. It also contained heavy metals and radioactivity.

The extent of the pollution is similar to that found in the conurbations of industrialized western countries in the fifties. The planned comprehensive restructuring of the energy base and the success of the measures taken to cut emissions will bring the state of the environment closer to that of the western laender.

However, this process of transformation will not take several decades like it did in the West, but will be accomplished at a much faster rate. This provides a unique opportunity for a scientific study of the effects of this relatively rapid change deriving from a reduction in pollutant discharges. Without a scientific study, it is impossible to predict the effects, in particular the causal "emission-transport-conversion-emission-effect chain."

For this reason, the BMFT [Federal Ministry of Research and Technology] is currently funding the joint research project entitled "Supporting Scientific Program on Saving the Atmosphere Over the New Laender" (SANA) to the tune of over 10 million German marks [DM].

A good third of those taking part in this pan-German research project come from the old laender and around two-thirds from the new laender. The project began at the end of 1990, when the research scene in the former GDR was being absorbed, restructured, and aligned with that in western Germany. The studies will center on the Leipzig-Halle region, where a scientific status seminar was also held in April 1992 attended by some 70 scientists from the old and new laender. They discussed the first phase of the research project, which is to record the state of the atmospheric environment.

The project is divided into five sections:

- emission of pollutants affecting the environment;
- distribution, trends, and transport of environment-relevant compartments;
- chemical conversion of air pollutants;
- modeling of behavior in space and time;
- effects on the ecosphere of the changing pollutant input.

A second phase of the project, lasting until the end of 1995, will indicate how the clean-up strategy is working and point to further ways forward to a clean environment.

German Institute: Solar Hydrogen Will Reduce CO₂ Emissions

92MI0743 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 9 Sep 92 p 4

[Text] Carbon dioxide (CO₂) discharges into the atmosphere can be cut by 80 percent by the year 2040 according to a study made by the Karlsruhe-based Fraunhofer Institute of Systems Engineering and Innovation Research (ISI) on behalf of Progas AG, Basel, for the

Federal Research Ministry. The study forecasts the possible trend in the coverage of the energy requirement in western Germany; the same trend can also be forecast in other industrialized nations.

In order to investigate the future significance of solar hydrogen as an energy source, around 200 individual technologies and variations in demand were integrated into an optimization model. The findings that emerged from the long-term scenario show that, initially, by the year 2040 CO₂ emissions could be cut by about 50 percent as compared with today's levels by rational energy consumption, exploitation of renewable energy sources, and the replacement of coal and oil.

Project leader Dr. Harald Bradke says: "If we are to achieve the even higher target of an 80-percent reduction, solar-generated hydrogen will be the main pillar of any CO₂ reduction strategy not based on the massive use of nuclear power. Hydrogen could then cover around 30 percent of the primary energy requirement."

At some DM220 billion, the total annual cost of the energy management system featured in the reference scenario for 2040 will be almost twice as high as current costs. If CO₂ is cut by 80 percent, the system will cost a further DM150 billion. But this is no cause for concern: Given the expected rate of economic growth, the relative cost burden will be much the same as it is today.

Swiss Company Invents Easily Recyclable Plastic

92WS0774B Stuttgart BILD DER WISSENSCHAFT in German Aug 92 pp 94-95

[Article by Burghard Boendel: "Here Today, But Not Gone Tomorrow"; first paragraph is BILD DER WISSENSCHAFT introduction]

[Text] It is a fountain of youth for used plastics. A Swiss chemical company intends to get control of its plastic waste with aqueous solutions. With the new process, polymers can then be recombined into a high quality plastic.

Roland Belz could not let go of the idea with the sugar cube. The little object, according to the flash of inspiration of the inventive businessman, sparkles with an excellent recycling property. It is possible to transform a dirty sugar cube into a clean one without any problems: Simply dissolve it in water, purify it, dry it, and reshape it. Belz thought it should be possible to recycle plastic using this same principle.

Ten years have passed since this observation. First with the Battelle Institute and finally in his own company, Belland AG, with headquarters in Biberist near Solothurn in Switzerland, Belz worked on a technique based on this notion which is now ready for application. It includes not merely a single, new material but a whole family with one common property: During polymerization, carboxyl groups (COOH) are docked on the primary chain.

Whereas the primary chain determines the properties of the plastic, the carboxyl group enables specific water solubility. Belz explains the chemistry: "COOH is smuggled in, so to speak, as a predetermined breaking point in the polymer."

When the newly developed plastics come into contact with aqueous caustic solutions such as soda lye (NaOH), the sodium is released from the lye, the hydrogen is displaced on the COOH group, and reacts with the radical to form COONa. As a result of this regrouping, the thermoplastic plastic becomes a polymer salt which dissolves in water. Here, the individual polymer chains which normally are firmly entwined in a ball and only slightly relaxed by warming for processing, swim freely side by side. Fortunately, health threatening monomers, i.e., the starting components of the polymer, are not formed.

With a second dip into the bag of tricks, the plastics are then recovered. If the basic polymer soup is neutralized, for example, with sulfuric acid (H_2SO_4), hydrogen displaces the sodium from the COONa compound so that the original condition is restored in the carboxyl group. Sodium and the remaining sulfate (SO_4) combine to form (Na_2SO_4), and the plastic precipitates. That is the functional principle: Belz will not divulge the specific lyes and acids, "That is our black box."

The dissolving and precipitation do no damage to the plastic: "This transformation can be repeated umpteen times without changing the quality at all," Belz determined in countless series of tests.

Thus, the Belland process provides three basic advantages:

- While the plastic is in use, it does not differ from other polymers. It has a precise profile of properties.
- Sorting is automatic based on the dissolution property. From a dirty, mixed plastic cocktail, the lye dissolves out only Belland material, which is then available as a contaminant-free type.
- The plastic is purified down to the polymer chain. Any contamination which has worked its way in is eliminated. At the end of the recycling process, there is a hygienically problem-free material which can be used in any way. However, to make recycling simple and economical, the actual palette of plastics is designed according to the modular principle. The foundations for this are three basic polymers:—An acrylate copolymer with a rubberlike, soft consistency,—A styrol acrylate copolymer for hardness and temperature resistance,—An adhesive component.

All products made of Belland plastics such as films, coatings, injection molded parts, fibers, or adhesives are composed of these three components. For each product the applications engineers specify the exact mixture of the individual components to provide the required set of properties.

This requires great precision. Because the plastics of the Belland trademark do not have the broad spectrum of properties that the standard polymers polypropylene and polyethylene have. The reason for this is the carboxyl groups. They make the material brittle and amorphous. "Consequently, we have to know whether the material is to go to the refrigerator sector or to end up as a swizzle stick for coffee," says Belz.

The composition is defined based on the intended use. A bubble pack such as that used for tablets consists of 10 percent styrol acrylate, 88 percent acrylate, and 2 percent adhesive. Consequently, according to Belz, marketing and applications engineering cooperate very closely.

The first recycling step occurs at the plastics sorting facility: From there the filtered mixture, in which only water soluble impurities are still found, moves in tank cars to the central recycling facility. This is currently being built on grounds of the BUNA AG in Schkopau, Sachsen stop. The polymer precipitation performed there is preceded by water purification, which begins with fine filtration, passes through the anaerobic stage, and ends with sterilization.

The only problem after that is that the three basic polymers precipitate out together. "Of course, we could separate the three basic components by technical means," says Belland manager Belz. However, that would be extremely expensive and illogical, since they have to be remixed later anyway.

Consequently, they take a different tack. New product is used to adjust the ratio of the basic polymers as well as their molecular weight required for the specific application. In a process not disclosed by Belz, old and new plastic are combined and precipitated together. "Thus we obtain an extremely homogeneous material," boasts Belz. With compounding, i.e., mixing of melts, this would not be possible.

Currently, the Belland people are working on refinements and on the construction of the production and recycling structure. Recently, the necessary additives have also arrived in the loop. The remaining brine is run through an electrolysis-like process for separation into acids and bases. The acid is then reused for plastic precipitation in the recycling facility; the clean caustic solution returns in the tank cars to the sorting operation to dissolve the Belland plastics there.

Such solid arguments will be needed by Belz to find additional business partners. Thus far, at prices of about 5 German marks [DM] per kilo, the Belland material has been not only significantly more expensive than standard plastics. The recycling is also not currently calculated in. However, cost-effectiveness is only a matter of time for Belz. In 1993 BUNA—currently the only raw material supplier—is supposed to deliver at least 30,000 metric tons of new material. 10,000 metric tons are supposed to be added from the recycling facility. If all goes as planned, the economic break-even point should be reached by the end of the year. After acquiring a

market share of 10 percent, i.e., approximately 40,000 metric tons per year, Belz believes he will be able to inspire fear in the competition in Germany.

To boost business, the managers of the Swiss company are currently on a tour of Germany with presentations primarily with plastics processors.

It is a good thing for them that there is virtually no change for the producers of plastic packaging. The Belland material is just as easy to process with conventional injection molding machines and with automatic film and deep drawing machines. The uniqueness of the Belland technique, summaries Belz, does not lie in a revolutionary invention but in a new consciousness: "We have simply turned production around."

Germany: Microorganisms Used to Clean Waste Water

92WS0804B Duesseldorf *HANDELSBLATT* in German
9 Sep 92 p B11

[Text]

Waste Water Treatment: Juelich High Performance Biogas Procedure Proven in Practice

Waste Problems Reduced: Less Sludge With Anaerobic Treatment

Microbial waste water treatment is an example of the way in which interesting innovations can come about through combined utilization of biological and technical concepts. An anaerobic treatment method was developed at the Juelich research center which not only handles heavily polluted waste water in an energy self-sufficient manner, but also provides excess energy for other uses.

Aerobic waste water treatment (activated sludge process) represents the most important continuous "fermentation process" for the treatment of municipal and industrial effluents in industrialized countries today. Atmospheric oxygen is principally used to supply the microorganisms. The primary goal here is high substrate turnover, but because of the aerobic operating method, a great deal of biomass (sludge) is formed.

The fundamental advantage of the aerobic method is that sufficient energy is available through oxidative degradation of the carbon source for multiplication of the microorganisms, which act as the biocatalyst. This sludge discharged with the treated water must be separated and disposed of. A waste water problem is thus transformed into a solid waste problem.

Aerobic Treatment Involves Waste Disposal Problems

The waste water is biologically treated in the aeration tank and then separated mechanically from the bacterial culture. Part of the concentrated biomass is returned to the aeration tank in order to maintain a high level of catalyst there. The excess sewage which results, a principle disadvantage of the so-called aerobic process,

cannot be avoided and must be disposed of. A significant reduction of sludge is only possible with so-called anaerobic procedures (biogas processes).

While in the aerobic process up to half of the carbon from the sewage components can reappear in the sludge, 10 times less sludge is formed with the anaerobic process. Instead, up to 95 percent of the carbon source is converted into biogas (methane and carbon dioxide) and less than 5 percent is transferred to biomass. The reason there is ten times less excess sludge formation is that when oxygen is excluded and the organic load remains the same, about 10 times less metabolic energy is available for the microorganisms.

In order for anaerobic species to be able to exist under such limitations, there is considerable selection pressure on in favor of mutants with high metabolic activity (turnover). "High throughput" with low excess sludge formation is of great interest from the viewpoint of waste disposal. However, this unfavorable energetic situation for the microorganisms results in a low growth rate.

Of course, since they perform a catalytic role, as many microorganisms as possible must remain in the bioreactor. This is possible in practice through a series of measures for biomass retention or recirculation, by means of which the residence time of the waste water is uncoupled from the residence time of the microorganisms.

Selection in favor of pelletizing biomass can be achieved through generally empirical optimization of the process conditions. This principle or the corresponding procedural variant of the UASB [upflow anaerobic sludge blanket] reactor represents the most widely distributed type of anaerobic waste water treatment plant in the world today, with more than 100 plants operating commercially. However, it is difficult to reproduce the pelletization every time. In addition, there is the danger that the pellets will redissolve.

On the other hand, adsorption, i.e. the adhesion of microorganisms to surfaces, represents a widespread property in nature. However, there is the danger that the biomass will become detached. Porous supports offer the microorganisms especially large surfaces on which they can grow.

Lava scoria, a naturally occurring macroporous support material, is presently available for this type of colonization. Porous glass, a technical material with variable properties, can be used alternatively. The starting materials for this substance are glass and salt power of defined grain size.

Special Microbes Bred for Heavily Polluted Waste Water

If one mixes both components and sinters this mixture at high temperature, then a structure is formed from which the salt can be washed out with water after cooling. This

produces a glass sponge which has proven to be an ideal home for anaerobic microorganisms.

Microorganisms specially selected for heavily polluted waste water can colonize in sufficient densities for up to 150 m³ of biogas to be formed in a 1 m³ bioreactor per day. A so-called fixed bed loop reactor has proven its worth as a reactor design. In it, the greater part of the effluent from the fixed bed is returned to the fixed bed inlet via an external loop, where it is mixed with the reactor influent. Circulation is increased until the concentration gradient no longer plays a role.

This design kills several birds with one stone: First of all, circulation prevents toxic conditions in the lower part of the column. Secondly, with every cycle the biogas formed during one passage leaves the system, while the water is pumped back again. This prevents too many gas bubbles from blocking the inflow of new "feed." Thirdly, the flow can be arranged so that a considerable amount of biomass is still accumulated between the particles of tower packing material.

A basic prerequisite for high performance is the proper biomass on the proper support in a suitable reactor. In addition, because of the low multiplication rate of anaerobic microorganisms, optimal conditions for life must be provided by means of modern measuring and control engineering. The start-up procedure for biogas reactors can thus be optimized with respect to time while at the same time avoiding damage to existing biomass.

Footnote

Dr. rer. nat. Alexander Aivasidis, member of the scientific-technical staff of the Institut fuer Biotechnologie [Institute for Biotechnology] of the Forschungszentrum Juelich, [Juelich Research Center], Juelich.

French Firm Develops Antinoise Equipment for Factories, Autos

92WS0814A Paris L'USINE NOUVELLE in French
3 Sep 92 pp 59-60

[Article by Olivier Lauvige: "Using Noise to Create Silence"; first paragraph is L'USINE NOUVELLE introduction]

[Text] The technique of active noise control will soon plunge manufacturers, motorists, and housewives into a world of silence.

Noise has finally met its master: itself. By analyzing the wave of any din, and then emitting its opposite, active acoustic control can theoretically reduce the noisiest machine to silence.

The first patent on the concept was filed in 1930 by the German Paul Lueg. However, he did not have the technical means to put his theory into practice at the time. The fact is, clapping in time with your do-it-yourself neighbor to reduce the ring of his hammer blows does not help. Active control requires the real-time

emission of a "counternoise" whose characteristics are rigorously opposite to those of the noise you want to eliminate. Only the latest electronic developments, and especially those involving signal-analysis microprocessors, have enabled engineers to contrive the first active sound-deadeners.

Reducing Noise a Thousand-Fold

The devices consist of a pickup (microphone, accelerometer), an actuator (loudspeaker, piezoelectric element), and sophisticated electronics to drive the whole thing. Miniaturization makes it possible to house everything in small devices, such as the headset developed by the National Center for Scientific Research (CNRS) and marketed by the Marseilles company Technofirst. The sets are proving especially effective against deep tones whose frequencies are under 1,400 hzt. "Motors, which produce a large share of industrial noise, emit between 100 and 300 hzt," says Christian Carme, who invented the headset. "Passive techniques are often ineffective in this frequency range. Active control reduces motor noise by 30 decibels." That amounts to a thousand-fold reduction! But priceless though silence may be, manufacturers are still reluctant to invest in headsets that cost over 3,000 French francs [Fr] apiece.

However, they will soon be able to enjoy "active silence" without resorting to headsets, for Technofirst is also working on making an active, three-dimensional acoustical barrier that can isolate a person in an antinoise volume. All that is needed are computers and algorithms powerful enough to process and manage in real time a cleverly-spaced network of microphones and loudspeakers. Such a system installed in the headrest of an automobile seat or broadcast through the car radio will reduce engine and ride noise inside the vehicle. Although these applications are still at the experimental stage, they already interest many automakers. A host of other uses for active acoustical barriers can be imagined: sound insulation for each work station in a room of offices without partitions, sound deadening for a bedroom facing the street, and so on.

But until we can start sleeping with our windows open, the Building Trades Science and Technology Center (CSTB) has developed active double-pane windows. A microphone placed outside the window varies the pressure of the air trapped between the two panes through a digital filter in a loudspeaker. The system is very effective at low frequencies (-20 dB) and the French National Railway Company (SNCF), which is said to be thinking about equipping its high-speed-train cars with it, is particularly interested.

It will soon be possible to reduce the cost and amount of space taken up by the microphones and loudspeakers by replacing them with magnetostrictive ceramics. These ceramics are similar in behavior to piezoelectric materials: They change dimensions and shape when exposed to a magnetic field (as opposed to an electric field for piezos). But they produce greater efforts and respond to

higher frequencies as a result of recent developments in tefermol-D, an alloy consisting of 49 percent cobalt, 49 percent iron, and 2 percent vanadium. The material's principal asset, however, is its ability to reverse capacity. It can serve as both a pickup and actuator. When bonded to the surface of the glass, it reacts to acoustical pressure and directly emits a magnetic field that is converted into an electric current. Correctly processed and dephased, the electric current activates the same ceramics to generate a countervibration.

When the sources of a noise are well-known and localized, it is often better to reduce them at the source rather than shield against them. One example is the nagging hum of ventilation ducts. A detection microphone placed upstream of the duct system picks up the noise to be eliminated, feeds it to a digital filter controlled by a microprocessor, and activates a counternoise loudspeaker. An error microphone positioned downstream recovers any residual acoustical pressure and provides feedback to the digital filter to optimize the system's performance. Technofirst has already succeeded in reducing the operating noise of two pilot applications by 20 percent.

This type of active noise control has also been applied in the United States by the Noise Cancellation Technologies Company of Stamford, Connecticut. The company reduced the whirl of a suction unloading machine that generated an unbearable din of 123 decibels! That is the equivalent of an airplane taking off. A set of microphones and loudspeakers placed in the right spots around the machines reduced the noise pollution by over 10,000!

This technique could spell the demise of mufflers. The American transport company CSX is considering using it to counter the backfire of internal combustion engines using an identical, but dephased, sound wave. Initial tests have been reliable. Only the still-exorbitant cost of these electronic mufflers is keeping traditional ones from the junkyard.

But the giant Dutch electronics firm Philips has already, and just recently, created a joint-venture with NTC to develop electronic systems to reduce industrial (air-conditioning, electric generators, automobiles) or domestic (mixers, vacuum cleaners) noise pollution. "It is still just a small project" is the reserved comment of a Philips official when questioned about the new market, a market where silence is golden.

Boxed Material: From Antinoise to Antivibrations

Noise is vibration. So anything that reduces one deadens the other. Several companies have used that observation as a starting point for the study of active antinoise techniques to combat vibration in rotating or alternating machines. Hutchinson, for instance, has used the control algorithms of Technofirst to develop an active shock absorber for car engines. It consists of an accelerometer-type pickup to detect chassis vibrations. A microprocessor analyzes the information in real time, and the data

are used to modulate the movements of a small jack actuated by a linear motor. The whole thing is wrapped in a rubber piece that changes shape depending on the inverse wave of the vibrations to be damped. These active shock absorbers, which are the same size as conventional ones, reduce the forces the engine transmits to the vehicle chassis by 40 dB in bench tests. "Tests on a real automobile will be conducted during 1993," says Andre Guennesseaux, who is in charge of the project at Hutchinson. "And many automakers are interested."

The Bertin Company has also designed and manufactured an active-control antivibration unit. The company's process eliminates extraneous vibrations and improves the positioning accuracy of motorized structures such as robots, cranes, or high-speed transfer machines.

Eastern German Firms Develop Environmental Technology

92WS0829A Frankfurt/Main FRANKFURTER
ALLGEMEINE in German 15 Sep 92 p B15

[Article by Michael Baufeld: "Livelihood Based on Hazardous Environmental Waste; East German Firms Developing Environmental Technology as Future Market"]

[Text] In the spring of 1990 chemist Udo Linke without further ado set up an environmental laboratory in Mitteltal, Brandenburg. Facing the demise of his employer, a water supply company, Linke made himself independent with his AnalyTech Engineering Company. The first job consisted of soil tests for small gardeners—the job brought him all of DM380. But orders soon began to pile up. Since Linke's firm analyzes air, soil, and water, looks for environmental damage, and offers the know-how for eliminating it, Linke is one of the many founders of small businesses in the new states who see a market for the future in environmental technology, just as do traditional capital goods manufacturers. They make their living from wind, waste, and murky water, from the hazardous environmental waste of past decades. They count on the tremendous need for rehabilitating the environment in the new states. In the opinion of the Federal Office for Environmental Affairs, the environmental technology established in the former GDR corresponds to the state of technology in the old states in the early 1960s. The need for investment is correspondingly great. How much will have to be spent all told to clean up the environment in the new states cannot be anywhere near exactly estimated. Estimates range from DM100 to DM750 billion. In the opinion of the IFO Institute in Munich, exactly DM211 billion will be needed to even out the difference in the condition of the environment between the eastern and western parts of the federal republic. The IFO Institute estimates DM125 billion in investments for clean water alone. Huge sums will also be devoured to clean up areas containing old hazardous industrial waste. The state of Brandenburg, for example, estimates the cost at DM30

billion—not counting the not yet determined expenses for cleaning up the garrisons abandoned by the Soviet Army.

The market potential in the new states could bestow a continuous boom on environmental technology—especially in the fields of water, energy, and waste disposal and cleaning up old hazardous waste. For the moment, however, the boom is more wish than reality. Since the reality is determined by a shortage of funds. Over DM20 billion a year in investments are needed to bring environmental standards up to the “level of the West” by the turn of the century—the market in the new states will not attain this volume that quickly. Not only is the shortage of money slowing down the upswing in the eastern German environment industry. The dispute over the energy industry—the action brought in Federal Constitutional Court by over 160 eastern German municipalities against the electric power contract—is holding up many investments just as is the tug-of-war between the municipalities of some regions over the legacy of the GDR water companies.

Western Germans One Step Ahead

Eastern German suppliers of environmental equipment and technologies face yet another obstacle in the race for orders: strong western German competitors who are often one step ahead of them because of their references and extensive connections.

Every now and then, an eastern German competitor has an unpleasant experience. Thus, the water supply company in Markkleeberg, a town at the gates of Leipzig, had ordered a sewage pump from a firm that is right around the corner from it, the Carl Enke Company in Schkeuditz. Foundations had already been poured and pipes laid for the pump at the place where it was to be installed when the order was canceled by telex. The head of the company, Hermann Enke: A western German builder of plants had taken over the outfitting of the pump station. Enke said that, in so doing, a better pump was not really installed, but a very expensive one because of costly modifications. Blows below the belt like this one hit the Schkeuditz firm hard, a firm that is a manufacturer of pumps and blowers, founded as early as 1886, compulsorily nationalized in 1972, and once again in the possession of the Enkes since 1990.

Get one foot in the market or go under—this is the alternative that many eastern German businesses face. A number of former VEB [nationally owned companies] that manufacture machines and instruments are increasingly trying to get into the business of environmental technology because the marketing channels for their traditional products have been severed. This is what the Grimma Machine and Equipment Manufacturing Company in Grimma, Saxony, is doing in the fields of sewage treatment and soil rehabilitation or the Leipzig Equipment Manufacturing engineering firm is doing in the fields of water and air purification with its know-how. They take a rational view of their chances: There are

more competitors than orders, as Horst Schneider, the managing director of the Stassfurt Chemical Equipment Manufacturing Company, knows. Aside from equipment for the potash and soda industry, the company also sells filters for sewage treatment.

Formerly an engine supplier for the GDR shipbuilding industry, within a few months the Halberstadt Mechanical Engineering Company adapted ship engines for use in block thermal power plants, which produce both power and heat in a way that is kind to the environment. The company, located in Saxony-Anhalt, today belongs to the H.W. Urban, Ltd., and Company Management Limited Partnership, which was entrusted with the company by the trust institution to restore it to a sound condition. For Halberstadt Mechanical Engineering, restoring it to a sound condition means getting out of the red (several million marks in 1991 with a turnover of DM62.2 million) with the new line of business. After a half a year of testing the new development, Ingolf Meyer-Plate, responsible for this division of the company, hopes for a first order for the company, for a first, important reference.

Defeat Suffered

It will be hard to get them, not only because of the stalemate over the East German municipal works. His firm has already been booted out once. Of all things, in a municipality in the same state. At the beginning of the year the order for a thermal power plant in Stendal by the Halberstadt Mechanical Engineering Company was almost perfect. But, the city decided to build the thermal plant with private investment because of difficulties in financing it. The Munich cooperative, BVT, stepped in as the financial backer.

And the latter demanded a patronage statement of the trust, to which the Halberstadt firm still belonged until April, a statement the trust was not prepared to give it. That catapulted the Halberstadt Mechanical Engineering Company out of the project. The general contractor was a well-known western German engine supplier whose 18-cylinder marine diesel engines are now supposed to be producing steam and power in Stendal.

Meyer-Plate suffered the defeat. In a bidding partnership with Siemens, the Hamburg Hanseatic company, and an Oder construction company, the mechanical engineering company is now ready for action in Frankfurt/Oder—eye to eye with BVT.

From Saul to Paul

The Central German Environment and Waste Disposal Company (MUEG), founded in 1991, got into the environment business faster than did the Halberstadt engine manufacturer. It also has an easier time of it: Its business is the cleaning up of the legacy of its parent firm, the Central German Brown Coal Company. Hazardous waste dumps are sealed using its own methods and dumping landscapes are stabilized. The Saul is converted

into a Paul—now a government philosophy for Saxony-Anhalt. The model: North Rhine-Westphalia, where the blooming environment industry likewise had its roots in the radical change in the “smokestack industry.”

Use of Wind Energy in Germany Viewed

92WS0829B Frankfurt/Main FRANKFURTER
ALLGEMEINE in German 15 Sep 92 p B21

[Article by Bernhard Richter: “Alternative Energies on the Way Up; on the Way to Economy”]

[Text] Since the 1970s, alternatives to the production of electric power based on uranium, coal, and oil have been increasingly sought. Water power has been exhausted to the greatest extent possible in Germany, solar energy is not yet worth discussing in terms of economic feasibility, and the suitability of renewable resources is only now being investigated. On the other hand, the use of wind energy to generate power will be economically feasible in the medium term—provided that the power supply law or equal treatment with coal is retained.

Chances for Wind Energy

Modern wind power devices have almost nothing in common with the windmills that have come into existence over the past few thousand years. They began to be developed 20 years ago and they have evolved in very different ways because of the different requirements for subsidizing their development in individual countries. While in Germany performance was optimized by manufacturers, in Denmark, for example, the focal point was the cost per kilowatt hour. Since the subsidy requirements were changed in Germany through the 250MW program, operating authorities today have better options, so that more economical machines are beginning to be produced. The goal must be to leave wind energy entirely to market forces in the medium term. The appropriate general requirements must be drafted by the Economics Ministry.

Wind energy is an additive energy since power plant capacity must be held in reserve in the event of calm weather. There is also a widespread mistaken impression that calm spells only arise regionally and that wind energy can largely and calculably contribute to the supply through the power grid system. Wind energy helps us to conserve fuels and in this way makes a contribution to protection of the environment and the preservation of resources.

State of Technology

Sufficient wind is a prerequisite for economical operation. This is to be found on the coast and offshore of it as well as in low mountain range locations and in the Alps. It is very hard to come up with an estimate of the actual usable potential since increasingly greater resistance to the erection of wind power machines is arising among the population and the optimal size of the machine is not yet known either. If machines 1 MW in size should prove

to be economically feasible during testing, offshore installation in the sea is to be considered. The mud-flat area of the North Sea coast will remain free of wind power machines for reasons of environmental protection, but the Baltic is available.

The state of Schleswig-Holstein is making an effort to generate 20 percent of its power needs with wind by the year 2010; a lesser percentage is to be anticipated for Lower Saxony and Mecklenburg-Hither Pomerania since percentage-wise less coastal area is available [in those states]. If offshore installation is included, these figures will certainly be exceeded. If the inland locations are included, this would result in a magnitude on the order of 2 percent of power production for all of Germany: a considerable contribution to protection of the environment. But before that, the technical prerequisites must be met.

There is still no consensus among the experts on products and arrangements for developing them. At the present time various ideas are still being developed and tested until they are ready for production; and this is absolutely necessary so that ideas are not rejected for theoretical reasons alone.

The testing ground at Kaiser-Wilhelm-Koog as well as the wind park on the west coast and the big 1.2-MW horizontal axis machine are indicative of the different kinds of devices that are being developed. The vertical axis machine does not require any wind direction tracking of the turbine room—but in return the power coefficient is lower. With such devices mechanically engineered components can largely be dispensed with, which lowers production and maintenance costs. In the meantime, the prototype of a 450-kw horizontal axis machine without gears, hydraulic system, and brakes is being investigated with the aim of producing a 1-MW machine based on it. The development of conventional machines with more costly mechanical engineering is also being pursued further. The next few years will show with which type production costs of under DM2,000 per installed kilowatt for the megawatt machine are possible. At these costs large machines too can be economically operated by the state without subsidies. This goal cannot be achieved with the small, under-100-watt machines favored by many operators, machines that are nearly as conspicuous against the landscape as the bigger ones.

The need for research on these devices still lies essentially in the areas of long-term behavior of the individual components, noise reduction, impact on the network, optimization of automatic controls, and various special considerations, such as the impact of lightning on the machine. Experiences with other sources of energy can only be applied to wind energy to a very limited extent since, aside from the requirement that the machine have a long life, there is the requirement that maintenance and repair be cost-effective. Care must be taken as early as during production to bring the two requirements into line with one another, and this can only be successful in

connection with meaningful statistics on damage. There is also not yet enough knowledge about the wind available. The measurements made up to now cover only ground winds for weather forecasts, not the energy at the level of the hub of the wind-power machine. Only a very limited calculation can be reliably made.

Breakthrough for Wind Power

Scientific study of prototypes at the testing ground at Kaiser-Wilhelm-Koog or at company locations, for example, the manufacture of small production runs, and observation of them as well as further opening to market forces will lead to more economical megawatt-class machines as well. And with this there can be a successful breakthrough for wind energy.

The opposition of the local population in windy areas is sharply increasing. Consequently, rural districts began to draw up areal use plans in 1991, the aim of which is to concentrate wind-power machines in wind parks. Manufacturers have to meet them halfway by developing slow-running, visually and acoustically acceptable machines. Conservationists' objections are the hardest to refute since they are not based on rational thinking. A lot more discussion will be required in connection with this to attain the goal of getting wind energy to be more widely accepted.

German Firm Develops Microelectronics for Environmental Applications

*92WS0829C Frankfurt/Main FRANKFURTER
ALLGEMEINE in German 15 Sep 92 p B26*

[Article by Ernst Joachim Preuss: "High Tech Makes It Possible; Microelectronics in Environmental Protection: Better Air, Clean Water"]

[Text] Possible uses of, focal points of development of, and the outlook for microelectronics were the objectives of a Microelectronics Society (GME) research project. The results of the study supported with Ministry for Research and Technology funds were presented to the public in June 1992.

Microelectronics is today one of the key technologies of great industrial importance for the next century. It contributes to environmental protection through measuring, control, and adjustment techniques (MCA). As a highly sensitive early warning system for pollutant emissions, on the one hand, and, on the other, to bring production and incineration and combustion processes closer to their optimal ecological performance, that is, into ranges of lowest emission and lowest energy consumption. In the production of electrosteel, for example, the tapping temperature could be adjusted to just as low as is necessary by continuous monitoring of the melt. This holds likewise true for the production of glass. In this case, expert systems could—limited by a high thermal inertia of the melt—reduce energy consumption by 20 to 30 percent and at the same time lower the emission level. According to the study in question, aside

from nitric oxide, pollutants like dioxins, carbon monoxide, or hydrocarbons emitted during combustion at power plants or industrial plants and not least of all during the incineration of waste can be considerably reduced through precise control of these processes.

Microprocessor-controlled adjustment techniques could further reduce private heating plant CO₂ emissions by about 15 percent. With about 10 million buildings, this means 27 million tons less carbon dioxide pollution a year. Another example: In the old federal states alone, there are over 15,000 dry cleaning plants in which sensors could be used to measure the tetrachloroethylene content for the automatic adjustment of the machine and to monitor emissions. A total of 25 branches of industry and sectors were included in the study, behind which lie concealed a large number of potential applications. Over and above this, the GME study was able to identify new fields of development relevant to the environment. There are, for example, deficiencies in the development of measuring sensors. There is a shortage of cost-effective sensors for use in measuring, control, and adjustment techniques at small and medium-sized production plants, that is, at precisely those plants that most contribute to overall emissions because of their large number. Additional focal points for research and development are to be found in the development of cost-effective sensors for the continuous quantitative determination of the amount of solids in fluid or gaseous media, of carbon monoxide concentrations in gases, and of a large number of organic compounds and heavy metals.

New Challenges

There is also a need for more action in the field of software. The performance potential of modern hardware cannot always be completely exhausted with the available supply of software programs in many applications. There is a lack of dynamic control models that are capable of simulating operating sequences as wholes. New software solutions and standard modules—realized, for example, as integrated, application-specific circuits—are needed, which simulate not only the behavior of analog controls. Memory programmable controls and computers that exercise control through intelligent, automatic optimization strategies are needed. The provision of tools appropriate for developing them is also an essential task. In connection with this, the authors warn against premature and overly specific employment of research funds in order to succeed in going from a reacting mode of action to a more forward-looking research and development strategy as concerns protection of the environment.

Further examples of future areas for the application of microelectronics to environmental protection are: control over the distance between cars [in traffic or on freeways] and lane control for cars, intelligent environmental information systems, and image-processing and pattern-recognition methods that are closer to the operations themselves.

When we think of the possibilities that will in future be afforded by chips and memory modules, the controlled three-way cat, as a pioneering application of microelectronics relevant to the environment in the production of automobiles, was a milestone on the way to new traffic systems. Today, into the third generation of vehicle electronics, it is a matter of tying the component systems into an overall system. A communications network that makes it possible to avoid control and automatic adjustment conflicts already exists. One of the next steps is the electronic linking of moving automobiles behind one another. This will not only improve the flow of traffic and reduce accidents, but will also sharply reduce emissions produced by traffic. The street system's capacity for absorbing traffic will at the same time sharply increase. The construction of additional stretches of roads and streets could in part become unnecessary.

Advanced information systems and data-bank applications will in future be another key area of application for microelectronics. With regard to this, protection of the environment will even assume the role of primary user and engine of development. For example, through potential access to differently structured data bases, these information systems will become an indispensable tool on the way to preventive protection of the environment. Success in this will depend on mainframe computer developments since enormous amounts of data will have to be processed very rapidly and in an up-to-date manner in terms of comprehensive models of the environment.

About 230 measurement technology problem cases are listed in the study. Despite considerable progress in analysis of the environment, there are still deficiencies in continuous in situ measuring techniques. For example, fast and reliable quantitative methods for detecting dioxins in the lowest air concentrations are lacking. Analyses of some water quality components cannot be continuously conducted "in the field" either. Monitoring is effected in the laboratory by means of discontinuously collected water samples.

While microelectronics already contributes directly or indirectly to protection of the environment in very many areas, there are still considerable demands on the technology to make even more intensive use of measuring, control, and adjustment techniques through further development of hardware and software.

FACTORY AUTOMATION, ROBOTICS

Italy: Results of National Robotics Project Discussed

92MI0751 Milan *MEDIAPLUSNEWS* in Italian
Aug-Sep 92 pp 18-23

[Article by Prof. Umberto Cugini, director of the CNR's Targeted Robotics Project and Daria Pietori: "Robots on Show"]

[Excerpt]

The Targeted Robotics

The goal of the CNR [National Research Council] targeted research projects is to involve both academic and industrial research groups in research activities that are considered to be top priority for national economic planning. The CNR coordinates these research activities to develop prototype products, processes, and services that can be transferred to Italy's manufacturing sector.

An example is the Targeted Robotics Project, one of the so-called "third generation" projects.

The Targeted Robotics Project was approved by CIPE [Interministerial Committee on Economic Planning] in May 1987 on the basis of a feasibility and prefeasibility study prepared by representatives from universities, industry, and the CNR.

The CIPE decision led to funding (in millions of lire) allocated over the five years of research activities:

- 1989—8,871
- 1990—11,076
- 1991—15,133
- 1992—15,388
- 1993—17,309

Possible working groups were singled out according to the new procedures for targeted projects introduced in 1987 that call for the presentation of research proposals on the basis of a list of topics resulting from the feasibility study.

The proposals submitted to the CNR by the November 1987 deadline formed the basis for the selection of potential working groups in April 1988 when the project organs were appointed and established. The Targeted Project is a national research program whose purpose is to bring together industrial and academic organizations to perform applied research. Research activities began in June 1989 with the first three-year working program of the five-year project.

The main goal of the Targeted Robotics Project is to upgrade the industrial and scientific sectors directly involved in robotics research, design, and utilization.

The project therefore focuses on developing through the design and construction of experimental prototypes, various areas of skills to identify the working systems of robots used for various applied tasks. The high technology research currently under way will have positive spin-offs on national industry.

The project is divided into four subprojects as follows:

Subproject 1 Robot Structures

Subproject 2 Robot Management

Subproject 3 Sensors and Actuators

Subproject 4 Robot Control

A transverse line of research also under way involves a market survey of robotics in Italy with direct reporting to the project management.

- The "Robot Structures" subproject, coordinated by Prof. Ario Romiti, concerns the strictly mechanical aspects of architecture and components that confer rigidity, operating precision, balance, dexterity and grip to robots that are used in various applications. The subproject performs research on modular structures, design and application criteria in semi-industrial models, structural analysis in dynamic conditions, advanced grippers, mobile robots and new mechanical models.
- The "Robot Management" subproject is coordinated by Prof. Marco Somalvico. Robot management refers to the group of processors that form the basis of the robot's interaction with humans when receiving specifications of the tasks to be performed and transforming these specifications into a group of elementary activities that the robot is capable of performing. Subproject 2 focuses on the following research topics: architectures and multimicroprocessors, programming systems and languages, artificial intelligence methods and techniques.
- The "Sensors and Actuators" subproject, directed by Prof. Vincenzo Tagliasco deals with sensors and actuators and vision systems. Actuators and sensors form part of the various subsystems and modules that make up the robot-system and include the devices that enable the robot to provide its various limbs with the ability to move (actuators) and to perceive the surrounding environment or to be aware of its inner state (sensors). The subproject provides for research activities in the field of sensors, integrated sensor systems, actuators, drives, and vision.
- The "Robot Control" subproject led by Prof. Fernando Nicolo deals with the movement of industrial robots located in a production cell. This subproject focuses on hybrid dynamic control and interacting robots, qualification of the robot in operation, programming of movements, configuration and management of robotic systems.

A total of 154 research groups from universities, industry, and the CNR are involved in the extensive areas of the Targeted Robotics Project.

Funding

During the first three years of the project the working groups received 30.93 billion lire in funding from the CNR.

Funding for these first three years, analyzed from the point of view of the project structure and the organization of the working groups is shown in Tables 1 and 2, while the percentage breakdown of funding is given in Figures 1 and 2.

Work Performed and Results Achieved

Given its long-term objectives and goals, the project was divided into a three-year working program followed by a two-year working program. The first three-year program focused on building "object," i.e. component prototypes for future assembly, wherever possible, in complete systems. The final two years will place emphasis on testing and certifying the components produced during the first three years in complete environments or systems to be built during the second working program.

All the objectives of the Targeted Robotics Project produced the prototypes that were planned for in the first three-year working program.

By the end of the third year more than 1,000 "objects" had been produced, articles published in international journals, software or physical prototypes built with relevant documentation, seven of which have already been transferred to industry, and three patents applied for. These patent applications, which were filed during the second year of the project, are briefly illustrated.

"The extremity of a robot arm integrated with a highly dextrous hand and wrist."

The patent was filed by the National Research Council, inventor Prof. Gabriele Vassura, part of subproject 1—Robot Structures, Research Line 1.4—Advanced grippers, Objective 1.4.1—Highly dextrous hands.

"High-ratio speed reducer without gears."

This patent was filed by the National Research Council, inventors Prof. Ario Romiti and Dr. Terenziano Raparelli, part of Subproject 1 Robot Structures, Line of Research 1.1 Modular Structures, Objective 1.1.1 Lightweight modular robots.

"Contractile composite materials and electromechanical devices that utilize it."

The patent was filed by the National Research Council, inventors Prof. Danilo De Rossi and Dr. Piero Chiarelli, part of Subproject 3—Sensors and Actuators, Line of Research 3.3—Actuators, Objective 3.3.2—Pseudomuscular Actuators.

Other patent applications covering the third year of research are currently being drafted.

A data base of the results achieved has been compiled in order to provide an analytical record of the results obtained by the project working groups.

The results, though not final, show that virtually all of the objectives stated in the working program and established by the feasibility study were achieved.

Table 1—Funding

	1989			1990			1991					
	Working Group	Funding	Scholarships	Working Group	Funding	Scholarships	Working Group	Funding	Scholarships	Working Group	Funding	Scholarships
Research Line	—	—	—	5	200	—	6	280	—	11	480	—
Sub-project 1	21	1,240	—	28	1,585	3	28	1,905	3	77	4,730	6
Sub-project 2	35	1,965	—	38	1,936	5	32	3,050	9	105	6,951	14
Sub-project 3	43	2,380	—	44	2,478	6	44	3,132	5	131	7,990	11
Sub-project 4	30	2,474	—	35	3,387	6	35	4,919	6	100	10,780	12
Total	129	8,059	—	150	9,586	20	145	13,286	23	424	30,931	43

Table 2—Funding

	1989			1990						1991		
	Working Group	Funding	Scholarships	Working Group	Funding	Scholarships	Working Group	Funding	Scholarships	Working Group	Funding	Scholarships
CNR	16	910	—	16	972	5	17	1,437	7	49	3,319	12
Universities	74	3,862	—	83	4,400	15	78	5,937	16	235	14,199	31
Funding	39	3,287	—	51	4,214	—	50	5,912	—	140	13,413	—
Total	129	8,059	—	150	9,586	20	145	13,286	23	424	30,931	43

Subproject: Robot Structures

- Lightweight modular robots
- Cartesian carbon-fiber robot
- Mechanical components
- Functional optimization of robots
- Very dextrous hands
- Multipurpose mobile remote control system
- Mobile robot with legs
- New mechanical models with multiple degrees of freedom.

Subproject: Robot Management

- ERMIA—Advanced integrated multiprocessor architecture for robotics
- Architecture for high dexterity grippers
- ALPI—Environments and languages for programming the actions of sensor-integrated robots
- PRORA—System for programming manipulator robots. The problem of recognizing form features in handling and assembling.
- FABER—Knowledge-based systems for supervision, programming, control, diagnostics and maintenance in a manufacturing environment.
- KROS—Knowledge representation system of self-reference robots
- TISANA—Artificial intelligence systems for modelling and recognition in mobile scenes for robot guidance.

Subproject: Sensors and Actuators

- Ultrasonic and electromagnetic tactile sensors
- Optical sensors
- Integrated sensor system for multicomponent force measurements
- Electrical actuators
- Pseudomuscular actuators
- Drive control
- Systems technology of drives
- Random sampling vision system
- Vision systems
- Vision architectures
- Laser camera system
- High-speed tracking systems
- Incoherent optical correlation system.

Subproject: Robot Control

- Hybrid dynamic control devices, software, and algorithms
- Hybrid dynamic control for locomotion
- Hybrid control and redundancy resolution for grippers
- Dynamic balancing of robots
- Automatic programming software for cooperating robot controllers
- Qualification of robots in operation
- Planning in quasi-structured environments
- Configuration and control of an automated cell.

[Passage omitted]

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Developments in German Machine Tool Industry Described

92WS0788A Berlin FERTIGUNGSTECHNIK UND BETRIEB in German Jul 92

[Article by R. Waetzig (Professor, Doctor of Engineering, Chemnitz Technical University): "METAV '92 Machine Tool Exhibit Between Knowledge and Hope"]

[Text] The German machine tool industry and its supplier companies stage METAV every two years. Organized by the Association of German Machine Tool Plants VDW, the 1992 exhibit ran 5-9 May.

Some 1,189 exhibitors from 29 countries, including 37 from the new Laender (States), courted the German machine tool market with its 17 billion German mark [DM] sales volume (1991).

Despite retreating sales figures, optimistic expectations prevail for the coming years.

METAV '92 fulfilled the promise of its organizers in that, despite the current weaknesses in the international machine tool industry, the optimism of the exhibitors in Duesseldorf was not affected. Generously appointed stands, newly developed machines, a broad supplier array, a variety of software, and an impressive stream of visitors suggested a rapid upswing in the economy, which, unfortunately, has not yet reached down to the business level. The increase in the number of exhibitors from the new Federal States (up to 37), including all the familiar companies—downsized to companies like Heckert GmbH, NILES Lathes Chemnitz, Schleifring GmbH—was heartening. The sharp competitive situation was brought home by the exhibit of machine tool products from the industrial power centers of Europe, the U.S., and Japan.

The statement made by the VDW with regard to METAV to the effect that in the face of a 15-20 percent increase in production costs for the competition, a rise of only 10 percent in productivity was achieved, was valid for the German machine tool industry. The free trade philosophy of the German producers was expressly emphasized, and government restrictions would obstruct it. In all estimates, the key function of the machine tool industry in a successful economy was justified. In general, the continuing challenge of Japanese products, both those directly exported as well as those produced in new Japanese plants in the U.S. and Europe, was evident in METAV. The estimate that the common European market of 1993 raises these chances even higher must be emphatically awaited. It appears that the caution of the Japanese in the face of the European CIM euphoria was

justified and the resulting strategies of the "lean production" philosophy released greater reserves. The German import rate of 15.4 percent, as compared to the Japanese rate of only 4 percent, indicates as much. Even more astonishing was Japan's domestic consumption amounting to 60 percent of its enormous machine tool production, which is roughly equivalent to the entire German machine tool production. It is to be noted that the inventory of machine tools declined by about 2 percent. The German machine tool industry has not lost its midsize character despite the publicized efforts towards concentration.

The technical level at METAV was marked by two product lines. On the one hand, by a more than broad offering of low-cost machines with and without NC, and, on the other hand, by complex cells and centers with CNC. In addition, supplier offerings of the greatest variety, which seem to make the targeted share of 75 percent of the final product easily attainable. Broadly represented at a high technical level were machine tools, controls, drives, sensors, mechanical modules, and software that effectively support the trend to a higher machine performance value (+12 percent per year). All major producers of cutting tools were represented, so that it was possible to make a good comparison of quality. The restraint of the large CNC producers GEFanuc, Siemens, NUM, and Mitsubishi with CNC was noteworthy, while the small competitors like FIDIA and several producers of CNC themselves have already completed their generation change over, without waiting for the 10th EMO 1993. What are the trends that may be deduced from METAV:

- increasing productivity through the use of better machine tools, including lasers, control systems, drives in the main motion (20 m/min thrust!) and a shortening of the additional movements (change times to 80 percent for 1990),
- increased quality with a guarantee of process safety to 1-2 IT classes improved by means of thermal compensation,
- ecology-friendly operations through the guaranteed removal of problematical products,
- new substitution and integration processes between procedures.

Even in these recession times, research and development are proceeding at a rapid rate. Even though the BMFT [Ministry for Research and Technology] provides support funding to the manufacturing engineering industry, the amount is small when compared with the activities of Japan's MITI, and fails to reach some sectors in need. Thus, the new German States do not receive sufficient support, as the shortcomings at METAV emphasize. The special show—"Production Engineering of the Future"—highlighted unusually interesting exhibits from six universities of the older Federal States.

University research in machinery manufacturing is always a combination of basic principles and applied research. The value of such research for the small and

midsize companies, which dominate in Germany, depends on an understanding and acceptance of that fact.

Research topics emphasized are new materials, new processes, new machines, new computational and planning methods, new controls, new actuators and sensors, but fewer structural questions dealing with machine tools.

New materials justify their higher costs by virtue of their new, improved properties. These properties should be comprehensively investigated. Limited, unilateral studies would only suffice for extreme cases, but mass introduction into the industry could not be expected from such an approach. Computational methods and production processes for composite fibers have been substantially improved.

Radiation technologies, like laser-integrated machining and water torch profile cutting, still remain the new processes with greatest potential.

New machines and hard-layered composite materials have led to substantially higher productivity and service life, which now approach the limits of machine tool capability. Movement has also come to the technology of fixing the tool to the machine, especially because of the transition to operating greater speeds.

With the increase in decentralized computer technology, new computational and planning methods are becoming more interesting to many companies.

New CAE/CAD and CAP/CAM-components, as well as control software, are proving indispensable in designing new machines and in the utilization of machines already in place. Some statistical data derived from METAV, which help identify new trends, are definitely of interest. For example, the total inventory of machine tools in Germany is about one million units, of which only about 13 percent are NC-controlled. In 1990, as before, because of cost considerations, 60 percent of the machines sold (especially to German manufacturers) were of conventional manufacture, while in the same period Japan installed more than 60 percent NC-machines. The reason generally given is more favorable prices.

METAV Highlights

CNC-Long-Turning Automatic Screw Machine

Thirty years after the introduction of the curve-controlled STROHM precision long-turning automatic machine, TRAUB has now shown its competence in the CNC-long-turning technology as well. Following are some of the special features of the TNL 16 line of products:

- owing to the large spindle hole (20 mm), no forcing of the material bars when fed from bar loader magazines even in the case of material bars with 16 mm Ø up to 15 machines,

- clamping range on the counter spindle is the same as on the guide bush,
- by means of slanted teeth the drive of the guide bush provides for absolutely synchronous speed between the main spindle and the guide bush,
- full track operation even when machining work pieces that are clamped in the counter spindle,
- C-axes on the main and counter spindles, and
- Y-axis on the counter spindle.

CNC Machining Center

In addition, TRAUB exhibited its newly developed, small TVC 200, which, with a working range of 400 mm x 300 mm x 400 mm and a work table of 600 mm x 300 mm, extended the TVC series downward.

The TVC 200, with its rapid motions of 30 m/min in all axes, machine change times of barely 1.5 s and spindle speeds of up to 8,000 l/min, is an extraordinarily fast machining center for smaller work pieces of up to about 100 kg in mass.

The TRAUB TVC 200 machining center can be equipped with the TRAUB-MX 8F control system.

CNC Single Carriage Lathes

For the first time, TRAUB presented its top model—the TND 300 G—of the series of CNC single carriage lathes TND 200/TND 300/TND 300 G/TND 350/TND 350 G/TND 400/TND 500 as a lathe cell with the TRAUB-IHS integrated handling system.

Automatic Grinding Machines

The Erwin Junker Maschinenfabrik GmbH, Nordrach, presented a unique process technology on the Quickpoint 5002 automatic grinding machine for external cylindrical-, fixing collar-, and square shoulder grinding on clamped camshafts using an abrasive wheel. The grinding is effected in the Quickpoint high-speed grinding process employing a superhard CBN-abrasive wheel operating at an extremely high peripheral velocity. This Quickpoint process reduces grinding time many times over.

Product quality with respect to concentric running, sphericity, cylindricity, run-out, and surface quality is improved by means of complete machining.

Heckler & Koch Machining Centers

The Heckler & Koch Maschinen- und Anlagenbau GmbH displayed three machining centers from the newly developed BA series. The BA 18 CNC, designed for small and midsize parts, is the smallest model of the new series. With a maximum speed of 10,000 l/min, it is—apart from steel—particularly suited for the machining of aluminum, non-ferrous metals, and plastics. The 'big sister' of the BA 18 CNC is the BA 25 CNC, likewise with a double table arrangement and moveable frame principle. It is designed for the machining of all conventional work piece sizes. This series is rounded off

by the BA 40 DNC, which has a traverse path of up to 2 x 1,000 mm in the two-place version and up to 1 x 2,750 mm in the case of the long version. Number three on the Heckler & Koch stand was the BA 35-2 CNC—the company's new two-spindle series. Heckler & Koch machines may, if the customer so wishes, be equipped with the H & K CNC 785-2 or the SINUMERIK 820 M control system.

Surface Cutters

HERTEL AG, Zuerich, presented the economical ISO surface cutter—with 45° and screw chucking—as a further development of the proven ISO surface cutter with a setting angle of 45° with chuck wedges.

In the development of the cutters, considerable importance was placed on achieving a good flow of shavings, which is accomplished by means of wide, axially opened shavings chambers. A high machining volume is achieved by means of a large positive shaving angle, even when less powerful machines are used.

HERTEL SEKX turnover plates in the HM-varieties P2F, PVA, and KM1 are available for use with the cutters.

The production and delivery plan calls for surface cutters with diameters of 50, 63, 80, 100, and 125 mm.

Milling Cutter

Krupp Widia GmbH, Essen, displayed milling cutter M 900 as a work horse machine for all steel and iron materials. Its flexible design comes with diameters from 100 to 315 mm and widths from 12 to 22 mm, which lend themselves to precise adjustment. In addition, this machine tool offers a high degree of production safety and good handling. Tooth advances of up to 0.3 mm increase its efficiency and lower manufacturing costs. Special milling machines with up to 1,000 mm diameter are possible through the use of standardized components.

A special characteristic of the M 900 milling cutter is its very sensitive adjusting element, by means of which cassettes and WSP can be inserted from the side with a precision of 2 to 3 mm. The radial accessibility of the adjusting screw is an advantage in gang cutters. The plate position remains fixed even under heavy loads and after long use, since the cassette is braced against the adjusting element in the axial direction.

Profile Grinding Machines

The basic design of the HAHN & KOLB profile grinding machine involves the incorporation of five CNC axes. The FANUC 15 M, which is fitted with the requisite interpolation parameters, is used as the CNC track control. The clearance angle is set CNC-controlled in the grinding head. During the automatic processing it can be continuously varied. In this way, several different or like size clearance angles in the range up to 17° can be ground everywhere in the profile form. The grinding of cutting

chamfers can be handled without difficulty. CNC-control ensures that wearing of the grinding disc diameter is compensated for.

To increase its autonomy, a round table can be introduced as the sixth CNC axis. Connections and hook-ups for a loading robot have been provided for. An integrated palette system permits the round table plate to be changed and positioned exactly in a few seconds. The machine is mostly used to produce highly accurate form turnover plates, flat bed machine tools, and for profile pressing and crush-rolling in hard metal alloys and HSS.

PD 200 Compact Lathe

This machine, also a HAHN & KOLB product, is designed for the "classic lathe" market. Its most important fields of use are for the production of precise small parts, finishing work, and training. By means of a broad, but optional, accessory program, the machine can be fitted for special tasks. It is characterized by a favorable price-performance ratio with minimal space requirements, high cutting and advance rates, and an eightfold machine revolver. Good removal of shavings by means of the 45° oblique bed and a hydraulic chucking device ensure high productivity.

A high degree of machining accuracy is achieved by means of hardened, cleared guidance paths, high-precision prechucked spherical roll spindles and central lubrication of the carriage guides.

High-Performance Lathes

The S 30 modular 2- or 4-axes-CNC-high-performance lathe center with mechatronic tailstock, without time-intensive quill adjustment, but with counter spindle for the backside machining, can be universally used for machining the feed component, shaft component, bars, or for complete machining, beginning in the workshop with small lot sizes right up to a serial manufacturing operation. It combines in itself those advantages that make economic success programmable. This machine was displayed by VOEST-ALPINE STEINEL of Austria. Some of its advantages are:

- up to two machine systems engaged simultaneously,
- the Y-axis with the greater process range with the powered machine (+/- 55 mm),
- high-precision in the axes influencing the diameter by means of linear, direct path measurement system for the X- and Y-axes and two-point in-process diameter measurement via the Y-axis with automatic correction value transfer; the best operability through the cycles packet developed by VOEST-ALPINE STEINEL;
- high operating safety thanks to the built-in collision and overload safety as well as diagnosis display on the CNC screen,
- an ecologically friendly design achieved by the greatest possible separation of oil from the cooling lubricant.

CNC-Cylindrical Grinding Machine

Based essentially on proven components, only the CNC-control is new. The combination of both elements successfully unite the advantages of conventional technology (e.g., the simple servicing) with the plus points of CNC-technology, namely, flexibility and automatic processes. With the K 19, the Swabian cylindrical grinding machine specialist has joined both processes. While the K 19 is a true CNC-cylindrical grinding machine, it can also be employed as a conventional machine. To do this, the main axes are simply moved by means of the swivel switch and in the X-axis, or, if desired, by means of a handwheel. This capability makes "hand grinding" possible.

For automatic grinding, the desired position is set on the Z-axis. The changeable points are simply set in the teach-in procedure both for longitudinal grinding as well as the machine table positions for insertion grinding. The true-off stroke can be defined and brought to speed in the same way. Thus, the speeds of the table movements are changeable in each kind of operation. The insertion rate, the feed rate for the longitudinal grinding, and the truing values are put in the particular menu.

The problem-free, uncomplicated handling precludes the need for any knowledge of programming. And yet it offers the same advantages as a CNC-control. A comfortable set-up, individual true-off, and the ability to be able to control the grinding process at any time the task so requires.

Grieshaber SFM 7205/NC-2 Superfinish Machine

The Superfinish is a completely automatic, NC-controlled process to produce defined spherical track profiles on cylinder and beveled bush rings. In order to produce defined spherical track profiles, a time superposition of the track has to be selected. To do this, a preprocessed machine has to be chosen whose width is substantially less than that of the track. The machine executes a harmonic oscillatory movement with small amplitude and high frequency. This harmonic oscillation is superimposed by an NC-controlled stroke movement of the machine. The velocity profile of the NC-controlled stroke movement can be selected as a function of the desired sphericity, so that the required time superposition profile results.

Automatic Lathe Cell

Under the designation "Rob," GEFAP GmbH, Wermelskirchen, offered its well known track-controlled CNC-lathe LUX-TURN LT 1 with an integrated articulated robot and conveyor belt. The LUX-TURN LT 1 "Rob" lathe center is equipped with an automatic pneumatic feeder and a rapid 32-bit control (type MELDAS 3L with graphics). Other specifications are: peak height 100 mm, peak width 400 mm, power of main spindle 2.2 kW, spindle speed 6,000 1/min.

MICROELECTRONICS

German Institute Helps Small Companies With ASIC Design

92WS0823A Munich ELEKTRONIK in German
1 Sep 92 pp 32-33

["ASIC for Small Companies: 'Shared'-Wafers Reduce Initial Costs"]

[Text] With so-called multiproject wafers, even small and medium-sized companies should be able to use ASIC designs. Several designs (by different partners) can now fit on one wafer, so that the mask costs per design become proportional to the required wafer area.

In the future, integrated system solutions will comprise a substantial part of the semiconductor market. The strength of European and especially German industry is chiefly based on system knowledge. In order to be able to stay ahead of the competition and secure the market position, application-specific circuits (ASICs) are specially suited for the integration of this knowledge. For that reason, small and medium-sized companies play a key role since, on the one hand, a high proportion of system knowledge is to be found there, and, on the other hand, it is precisely these companies that are able to react flexibly to new market requirements.

To help remove any trepidation these companies might have vis-a-vis ASIC designs, the project SMI-Support (small and medium-sized industry support program) came into existence in 1990 under the EUREKA project JESSI [Joint European Submicron Silicon Initiative]. So-called "support and competence centers" (SCCs) were established to assist the companies in familiarizing themselves with the development and use of ASIC designs. Besides the Fraunhofer Society Institute for Integrated Circuits (IIS) in Erlangen, the Society for Mathematics and Data Processing (GMD) in Bonn/St. Augustin, and the Institute for Applied Microelectronics (IAM) in Braunschweig, additional partners are found in the Netherlands, Belgium, France, Great Britain, and Italy.

The advantages of application-specific chips over PLDs (programmable ICs), namely, a higher utilization factor, shorter delay times, smaller scale, and appropriate copy protection, have—to be sure—been known for some time. Still the high initial costs, which are caused by the indispensable masks, frighten many companies off. If it involves a redesign, which is almost a self-evident truth in the case of analog/digital chips, these high costs (about 70,000 German marks [DM]) must also be assumed by the customer.

What is a Multiproject Wafer? In order to make ASIC designs profitable, even when only small numbers or prototype chips are involved, attempts are being made by means of so-called multiproject wafers (MPW) to reduce these one-time costs to a manageable level. To this end, many companies may decide to share a wafer,

with the costs being proportional to the share portions. In the case of a "five-design" company, initial costs of between DM10,000 and DM20,000 per customer (see Table) will be assumed. These initial costs are fixed costs for the customer, even if he only occupies a fifth of the wafer and five designs are not available for an agreed upon time period. According to Dr. Richard Hagelauer, department head at Fraunhofer Society in Erlangen, the wanting amount is then covered from the SMI support funds.

The design is effected in cooperation with the support and competence centers. Experienced ASIC producers, who also have the appropriate processes at their disposal, take over the production. Through the use of design tools produced by the Cadence, Valid, Silvar Lisco, or Viewlogic companies, problem-free cooperation becomes possible both with the customer as well as with many European semiconductor producers (ES2, Matra-Harris, Mietec/Alcatel, Phillips, Siemens, and SGS-Thomson Microelectronics).

Table 1. Commencing in 1993 the Fraunhofer Institute for Integrated Circuits Will Work on the Multiproject Wafer With Four Semiconductor Producers. Five Designs Are Planned per Wafer; Initial Costs Are Fixed

Semiconductor producer	Mietec/Alcatel	AMS	SGS	ES2
Process	BiCMOS (3 μ m)	CMOS (1.2 μ m)	BiCMOS (2 μ m)	CMOS (1.2 μ m)
Fixed costs (DM) per design for five customers	15,000	10,000	20,000	10,000
Availability	immediately	immediately	from 1993	from 1993

Who Can Make Use of This Technology?

Multiproject wafer service is not just available to first-users. Small and medium-sized companies, too, which previously had been occupied solely with user-programmable logic circuits, are now also offered the opportunity of converting these designs to mask-programmable chips (gate arrays, standard cells). There are four possible ways of using the multiproject wafer service:

- The company already has the necessary know-how as well as all the requisite tools available and can therefore carry out the complete development in house.
- The company implements the development in cooperation with an SCC (so-called "training on the project").
- The company bands together with other companies into a work group, for whom an ASIC is developed.
- The company develops a PLD, whose functional behavior is converted by an SCC to a mask programmable IC.

BiCMOS Process for Multiproject Wafer

Mietec/Alcatel now also offers its BiCMOS processes (100-V-DBIMOS, 40-V-SBI-MOS) for the MPW service. These processes, which are optimized to high voltages, are based on a 3- μ m-layout and facilitate the integration of typically 150 gate/mm². Both processes work with a maximum clock frequency of 15 MHz. Libraries with 130 analog and 46 digital cells as well as 9 digital E/A cells are available.

BiCMOS technologies are used, among other things, to produce Telekom ICs, motor and display drives, as well as being used for automobile and consumer chips. Andreas R. Meinelt, Mietec/Alcatel's business director for Central Europe, foresees analog/digital implementations with a growth of about 20 percent; he estimates the purely digital applications at 12 percent. In Fab 1 in

Oudenaarde, Belgium, Mietec/Alcatel currently produces roughly 160,000 4-inch wafers (3 to 1.2 μ m) yearly. It has done this since 1991. Fab 2 is to go into operation in Belgium as early as 1993. At that time, chips in 0.8 and 0.5- μ m layout will be produced with the 6-inch wafers.

TELECOMMUNICATIONS

Germany: HDTV Production Center in Oberhausen

92WS0762B Duesseldorf *HANDELSBLATT*
in German, 31 Jul 92-1 Aug 92 p 15

[Article by Georg Weishaupt]

[Text] What until now has been considered taboo in European industry is about to become a reality in North-Rhine Westphalia. For the first time the use of the Japanese system for high-resolution television, HDTV, is to be supported with German tax money. The Ministry of Trade and Commerce of North-Rhine Westphalia will assume 90 percent of the costs for the production center in Oberhausen, HDO [High Definition Oberhausen], where in the future films with the Japanese as well as the European HDTV system are to be produced under the same roof.

The spectacular cooperation of the "enemy systems" is reflected in the composition of the shareholders of HDO Studiobetriebsgesellschaft mbH, whose shares representatives of the enterprises intend to draw up today in Oberhausen. The Berlin production firm VTTV, which intends to participate with 35 percent of the common stock, worth DM 990,000, works with the Japanese production standard. It is based on 1,125 picture lines and a picture frequency of 60 Hz.

The second main shareholder, the BTS Broadcast Television Systems GmbH (35 percent) in Darmsdtadt, is

putting its money solely on the European production norm. This is scarcely surprising, since 75 percent of BTS belongs to the Dutch Philips Company—(25 percent is held by Bosch)—which together with the French Thomson Group is standing up for the European system. This system works with 1,250 picture lines and a picture frequency of 50 Hz. In addition to this the two Cologne firms of Gemini Filmproduktion (20 percent) and the copier plant of Hadeko (10 percent) intend to participate in xx HDO Studiobetriebsgesellschaft.

It was not easy to get the four shareholders to sit down together at the same table. The Philips subsidiary BTS had a particularly hard time giving their approval to the HDO project—and this even though at the beginning of negotiations about a year previously the additional support of the Far-Eastern system had not even been questioned. Apparently the managers of the electronics company, which was now in difficulties, had had to make numerous and repeated calculations. Or was it perhaps fear of contact with their competitor Sony, which supplies some of the HDO equipment?

The slow-moving negotiations caused HDO Managing Director, Gerhard Pach, to look around for further interested parties. According to HDO spokesman Klaus Simmering these included firms which work with the Japanese system. And since Pach was pushing for a decision, in order to get a green light for the transfer of the North-Rhine Westphalia support funds, BTS had suddenly come under strong pressure. "At the end it looked as though the train would leave without BTS," said Simmering. The strategists at Philips must not have liked the fact that only firms with Japanese equipment had been given support.

At the present time it is planned that the four shareholders will raise a further sum of about DM9 million in addition to the common stock. In this way starting losses of HDO Besitz GmbH, a 100 percent subsidiary of the city of Oberhausen, are supposed to be covered, and its money made available in the form of a loan for the construction of production halls on the site of the Osterfeld Mine in Oberhausen. The production facilities are to be rented for the long term to the operating company.

The loans of the four shareholders are the prerequisite for the HDO-Besitz GmbH being able to receive the money from the North-Rhine Westphalia regional Economic Assistance. This money, however, is not sufficient to raise the required one-fifth of the planned investments for the HDO Studios, which amount to DM113 million. The shareholders would therefore either have to put up more money or admit new shareholders, Simmering explained. The English entrepreneur Edwin D. Healy, who intends to build a large shopping center in Oberhausen, is also being discussed as a potential lender.

Simmering sees the HDO project as being completely free from any kind of HDTV ideologies: "We wish to

provide our customers from the TV, film, and advertising fields with whatever technology is best for their respective projects." According to Simmering there are many opportunities in Oberhausen for cooperation between the European and the Japanese system on the one hand and the film industry on the other.

Germany: Prospects for Mobile Telephones Viewed

*92WS0765A Duesseldorf VDI NACHRICHTEN
in German 10 Jul 92 p 2*

[Article by Regine Boensch: "D-Network Operators Start Mobile Telephone Sales—Digital Mobile Telephones 'Starting to Walk'—Service Companies in Particular Add Excitement to the Business"]

[Text] When Joachim Dreyer talks about digital mobile telephones, he gets quite enthusiastic. "By the end of this decade, a car telephone will be as common as the telephone is in the home today." Dreyer, head of the Association of Suppliers of Mobile Telephone Services adds: "Experts even expect that in the future mobile telephones will be the rule, and the fixed-base telephone network will be the exception." Well, this will probably still take a long time.

However, important events in the mobile communications area took place in the FRG in the past few weeks. Since the middle of June, Mannesmann Mobilfunk has been distributing digital mobile telephones to customers of its D2-network. D-1 operator Telekom celebrated the market introduction of its products in Bonn on Wednesday of last week. Continuous updates of the standard and the lack of functional telephones had delayed these dates for a whole year. Even now, the mobile devices got only temporary approval until the end of the year.

However, this does not bother the two network operators. They want to demonstrate the functions and performance of their products which they developed over the past two-and-a-half or three years as quickly as possible. "A completely new dimension in mobility," goes the advertising slogan of Mannesmann, Duesseldorf. From the very beginning, mobile telephone users can call on services such as roadside emergency service, hotel reservations or traffic information.

By the year 2000, Telekom plans to have almost 3 million customers in its D-network and—of course—become the leader in the D-network market. Telekom sells directly and offers three different telephones costing between DM2,650 and DM3,850. By July/August Telekom wants to have approximately 10,000 telephones available for sale.

However, the private competitor from Duesseldorf will see to it that Telekom, a subsidiary of the Deutsche Bundespost, will not have an easy time winning customers. Even now, Mannesmann Mobilfunk is "slightly

ahead." Since early on, the company has been concentrating on Nokia telephones, the first ones to receive the preliminary seal of approval from RWTUEF, Essen, and later approval by the Saarbruecken Federal Office for Telecommunication Approvals. According to the first report issued by Mannesmann, Duesseldorf, already 5,000 customers have a telephone number in the D2-network.

However, according to Ernst-Friedrich Baumer, general manager of the service supplier Talkline, excitement in this industry will come from the suppliers of services. He and his 11 competitors are currently preparing customized packages—mostly for D1 and D2. However, they do not disclose which operator they prefer.

However, communications retailers are skeptical when it comes to the new networks and telephones in particular. "At present, we still recommend C-network devices," says Rainer Jergler of Etschenberg, the largest communications retailer in Duesseldorf. All eight D-network telephones which Etschenberg wanted to sell had to be returned to the manufacturer after a short time. An emergency call center in Duesseldorf which was to be equipped with the new telephones also broke down. In both instances, the software had to be updated.

Jergler feels that this is quite understandable. "Digital mobile telephone technology is like a small baby—it is red, screams, and you cannot do much with it yet. This will change in 1993, when the network has learned to walk."

Mannesmann Mobilfunk and Telekom can only shake their heads when faced with such restraint. "Try for yourself," that is how they and the suppliers of services challenge the doubters. And they point to their own telephones which they are already using for communication. The coming weeks and months will show whether their optimism is justified.

Germany: ISDN Technology, Market Expansion Discussed

92WS0819A Duesseldorf VDI NACHRICHTEN
in German 28 Aug 92 p 13

[Article by Juergen Janik: "ISDN Pays For Itself Slowly"; first paragraph is editor's lead]

[Text] Berlin, 28 Aug 92 (VDI-N)—In numerous brochures and advertisements, Telekom is courting its potential ISDN clients. It is persistently seeking new customers. Some small firms have already recognized the advantages of digital technology. The integrated services digital network is arriving in enterprises. Any connection faces delays and forms.

By the end of 1992, we will have sold 120,000 Basic and 10,000 Primary Rate Interfaces in Germany, predicts Karl Thomas, Telekom's ISDN business manager. While development of the service started only in 1989, ISDN [Integrated Services Data Network] is now available to

90 percent of all business customers in the old federal states. Telekom advises that the network will be extended to the remainder in 1993. The target in the new federal states: 1995.

The disturbing noise and clicks, rather the rule than the exception during international calls up to now, is a thing of the past for the enterprises which have "bought" the ISDN. Data transmission on an analog telephone network in the presence of concerted noise can especially be "try and error;" the loss or erroneous transmission of several bits quickly leads to unacceptable errors. Even modern modems which continually mask out bad analog frequencies run into their limits during international line problems. In most cases, the shift in the past to the Datex-P, the already digital data network, has proved to be less profitable because of cost. According to Telekom's vision of the future, ISDN which is to replace the analog network as well as the existing digital services such as Datex-P, Datex-L or Telex promises to get rid of all the disadvantages once and for all. To make ISDN available throughout the federal area, Telekom is successively converting all exchanges to digital equipment.

Telekom has an application form for ISDN communication that is difficult for the layman, but it does document the entire selection of new equipment and its performance. Before going to the nearest telephone office or Telekom store—plan on about two hours for this—one should carefully consider whether telephone, telefax, teletext, video data, data communication devices or even a video telephone is to be operated by using ISDN.

One should also have a clear idea of how much performance capacity is required. Telekom offers currently two possibilities: the so-called Basic Rate Interface and the Primary Rate Interface. Often the simple Basic Rate Interface is the very thing for a small business. It has two channels for voice and data communication with 64kbit/s, a D [data] channel with 16kbit/s for control and signaling, and a channel with 48k bit/s for synchronization and other tasks. It is technically implemented as a so-called S₀-interface by a NT (network terminator). In everyday communications, this means: two telephone calls simultaneously, one telephone call, one fax or even two parallel data transmissions.

Telekom is offering higher performance with the Primary Rate Interface. it can make up to 30 B [bearer] channels available. But the increase in performance has its price; Telekom charges a basic rate of DM518 per month. The Basic Rate Interface, however, shows favorably in the books with "just" DM74 per month. Added on to these interfaces are 23 pfennigs per charge unit. Also to be paid for are the gateways to other services, such as Datex-P or Btx [video data]. But here too is the ISDN interface paid for. Thus, the basic rate for a Datex-P gateway for 2,400 bit/s is DM140 per month; for a main interface, you would have to shell out another DM100.

The monthly basic rate for ISDN, assuming regular data communication, pays for itself quickly; however, the ISDN transmission rate with 64kbit/s compared with a modem operation in an analog network is obviously higher. Telekom makes these computations of comparison: Using an ISDN-PC, about 70 pages of text can be transmitted for a tariff unit of 23 pfennigs (daytime within the west zone, e.g. from Munich to Hamburg). Using a modem (9,600 bit/s), transmission of the same amount of data on an analog network would cost seven times more.

ISDN offers not only better quality and speed; some additional features are also useful for many subscribers in their everyday work. Those using the service already have a new ISDN telephone which displays the calling number for almost every incoming call (exceptions are private and unlisted numbers). For businesses with branches or people on the go, call forwarding is of interest.

The catch: Costs for call forwarding are borne by the subscriber called. In contrast to an analog network, the call is forwarded in a second and without the well-known "Your call is being forwarded...". Also potentially helpful is the change in service, e.g. when you want to switch an existing connection from a telephone to fax.

But so many digital "frills" require the corresponding hardware and software on the customer side. In every office, there are now many analog telephones and attachments as well as telefax machines which in very few cases operate in the digital mode. Should everything therefore be taken to the electronic scrap heap? Not in most cases. Telekom and many private vendors have developed a wide variety of adapters, which "bring up and running or keep running" even good old analog equipment under ISDN. A terminal adapter allows traditional terminal devices access to ISDN through the usual interfaces (V.24, X.21 or V.35). Thus, for example, an old V.24 modem can still be used. Advantage: The transmission speed is considerably higher.

Another way to connect old analog devices to ISDN is to rent or buy an ISDN telecommunication device (TK). For the small user, Telekom offers, for example, the octopus M device. The device costs about 250 DM per month on a ten-year lease. The basic configuration provides for up to eight analog and three ISDN connections.

Telekom's massive PR [public relations] activities of have led to ISDN capacity being nearly all used. Thus, there is up to a half year wait for an ISDN connection in Berlin.

Next week: Multimedia—The New Chance for PC [Personal Computer] Manufacturers?

Photo Caption

1. p. 13: The analog telephone and telecopier can still be used with the universal digital network. Terminal

adapters allow traditional devices access to ISDN through the usual interfaces. Photo by Telekom. [not reproduced]

Germany: Telekom Develops FIFO Storage Device Using CMOS Technology

92WS0819B Duesseldorf VDI NACHRICHTEN
in German 28 Aug 92 p 14

[Article by vwd: "Telekom Develops Its Own HDTV Chips; Circuits Reduce Throughput of High Definition Signals for Cable; The Image Is Divided in the Transmitter"]

[Text] Bonn, 28 Aug 92 (VDI-N, vwd/ftz)—Telekom, the German Bundespost research institute, in the FTZ [Telecommunications Engineering Central Office] in Darmstadt, is working on HDTV [high definition television] signal coding which reduces transmission capacity. In an announcement from the postal enterprise, it says that for Telekom, as the operator of telecommunication networks, it is important to reduce the high throughput required for HDTV transmission to be able to also economically televise this standard for the mass medium.

The compact engineering implementation of this method of coding as a large-scale integrated [LSI] semiconductor chip—the decoding must be performed in every home receiver—imposes therefore enormous requirements on the architecture and technology of the microchips.

Telekom writes that Telekom circuit designers have succeeded in designing a chain memory (FIFO [first in first out]) for clock rates up to 130 MHz in CMOS [complementary metal-oxide semiconductor] technology. With this chip, 8-bit data words can be read in and, independently from that, be again read out with another clock rate. Both a read in and a read out can occur up to 130 million times per second (this corresponds to 130 MHz). Up to a maximum of 1,296 data words may be put into memory. The chip may be used in various circuits for HDTV coding.

In comparison, the fastest FIFO chips on the market to date operate at about 70 MHz. Other LSI chips were developed by Telekom in a joint project with the University of Hannover. Besides Telekom, the Bosch and SEL firms are also interested in this research project.

The goal is to reduce the throughput of the HDTV signal so that it can be televised through a 140 Mbit/s channel. In doing so, the coding and transmission have to meet the highest quality standards. To implement the desired reduction to about an eighth of the original amount of data, the HDTV image is divided into four signal components which are then separately coded. One of these components corresponds somewhat to the normal television image, while the others hold the fine and finest image structures. A special analyzing chip has been designed for this difficult partitioning which must occur

in the transmitter, while the image is put together in the receiver by synthesizing chips. Although each chip has 450,000 transistors, the task cannot be accomplished with one chip alone and therefore several must be used. To fit so many transistors on a silicon chip only a square centimeter in size, all basic circuits and accompanying connections were designed by hand to meet the functional requirements.

Excepting the RAM [random access memory], according to the description by Telekom, these chips are classed among the most complex fully custom circuits ever made in Germany for research purposes. They were made at the Intermetall semiconductor plant in Freiburg.

France: Telecom Satellite To Broadcast Two Channels in D2-MAC

Details of Transmission

92WS0822A Paris *ELECTRONIQUE HEBDO*
in French 10 Sep 92 pp 1, 12

[Article by H.T.: "Telecom 2A Gives a Boost to D2 MAC"]

[Text] On Monday, 7 September, the Postal and Telephone Ministry announced Minister Emile Zuccarelli's decision to authorize the Telecom 2A satellite to broadcast four D2-MAC and seven SECAM channels that are now available on cable. According to the minister, the agreement signed by Canal Plus's Andre Rousselet, the state secretary of communication Jean-Noel Jeanneney, and the president of France Telecom Marcel Roulet "marks a decisive step in the promotion of big-screen 16/9 television, which can only be broadcast using D2-MAC, and the growth of direct satellite reception."

Canal Plus has committed itself in the agreement to making "special efforts" to broadcast in 16/9 format, in exchange for the right to use Telecom 2A to broadcast a group of seven SECAM channels that are scrambled using the station's new encoding system Syster. Canal Plus has marketed the channels as direct-reception satellite channels through one of its subsidiaries, Canalsatellite. The stations are already available on cable, and [the programming for] some of them is produced by a Canal Plus subsidiary called Ellipse.

Three D2-MAC channels have already been selected. One of them will duplicate (at 80 percent) Canal Plus's film broadcasts in 16/9 and retransmit sporting events.

The two other channels are Cine-Cinema for enlarged-format films and Antenne 2 (France 2 as of Monday). France 2 has "been asked" to step up its efforts to broadcast sports and most of its movies in 16/9. The most useful part of the 16/9 pictures will be selected when programs are simulcast in 4/3.

Four Ways to Receive Telecom 2A

Television viewers will have four ways to receive Telecom 2A. Customers who wish to receive only SECAM channels will purchase a terminal including a tuner-demodulator and SECAM decoder for about 1,500 French francs [Fr]. Canal Plus will supply them with a Syster decoder, developed by Sagem Co., when they subscribe. To receive everything, viewers will need a versatile terminal (tuner-demodulator, D2-MAC and SECAM decoders, Eurocrypt descrambler). These are being marketed by several equipment makers, including Philips, Nokia, and Amstrad, and cost between Fr4,000 and Fr6,000. Some of the terminals are modular and some are housed in a single unit. Customers also buy the dishes (Tonna is a big supplier). The cost of a SECAM installation will be less than Fr3,500; a D2-MAC and SECAM installation will run about Fr7,000. For cable reception, France Telecom is offering the Visiopass terminal to cable operators, who rent it to their subscribers. Other suppliers for all this hardware are expected to spring up quickly and bring down prices fast. The broadcast studios of Canal Plus are already equipped with 16/9 gear.

The number of cable subscribers (1.1 million) and direct satellite receivers (0.1 million) in France is quite low compared to Germany or the United Kingdom. Getting Telecom 2A going may enable us to catch up a bit. Kagan World Media, a research firm, predicts there will be 2.2 million cable subscribers and 0.7 million direct-reception installations by 1996.

Commentator Sees "Half-Step"

92WS0822B Paris *ELECTRONIQUE HEBDO*
in French 10 Sep 92 p 36

[Article by J.-P. D.M.: "D2 MAC Half-Measures Could Lead to a Half-Failure"; first paragraph is *ELECTRONIQUE HEBDO* introduction]

[Text] Canal Plus has only committed itself to transmitting two D2-MAC channels in 16/9 format on the Telecom 2A satellite (see pages 1 and 12).

Canal Plus's president Andre Rousselet scored a victory over French government authorities when he succeeded in getting his seven channels on Telecom 2A, and in transmitting them in SECAM 4/3 with Syster scrambling as he wanted. He will pay a pittance for this guaranteed monopoly: Fr25 million per year, per channel to rent the repeater—a low but normal price—and about Fr50 million to convert to 16/9 and transmit two of his stations in D2-MAC. (The third, Cine-Cinefil, will be broadcast only in D2-MAC 4/3. One has to wonder why this old-movie channel, which does not require high quality, was chosen over a sports channel, where the 16/9's extra inches would have been appreciated. As for the startup of a future channel, it is too hypothetical to merit discussion. Finally, Canal Plus will not, in practice, pay to rent the D2-MAC

channels.) To make its lack of interest in D2-MAC abundantly clear, Canal Plus will not include the price of the D2-MAC decoder/descrambler in its subscription rates for D2-MAC channels.

It is true that Mr. Rousselet was the only one to propose anything to "occupy" the Telecom 2A satellite, which is dedicated to D2-MAC but unused. It is also true that, since the news of successful experiments with compressed digital transmissions in the United States, Mr. Rousselet considers the D2-MAC standard outmoded. But D2-MAC is so far the only available 16/9 vector that is capable of offering a technical improvement viewers can see. We must decide: Either France has an industrial policy for television or it doesn't. If it has one, viewers must be offered a real service, that is, the possibility of getting at least the five traditional channels in D2-MAC (at least three of which must be in 16/9 to "prime the pump"). And they must be able to get them using one Eurocrypt decoder and a single antenna that picks up one or more satellites in the same orbital position. If France has an industrial policy, it will have to find a way to offer TF1, France 3, and M6 three D2 MAC 4/3 repeaters on a future satellite—in the same orbital position as Telecom 2A—for at least three years. The marginal cost would be three times Fr25 million over three years, or Fr225 million. Not so bad, really. In fact, if it is truly necessary to add a satellite with three D2-MAC channels, why not place the latter in the same orbital position as TDF1 and TDF2? Those stations' four D2-MAC channels—France 2, Canal Plus, Arte, and MCM—are now working well. Such a move would create a package of seven D2-MAC channels, two in 16/9 and only one pay-TV—an attractive alternative to Mr. Rousselet's SECAM package for subscribers only.

Denmark To Provide Fiber-Optic Link to Lithuania

92WS0831C Paris AFP SCIENCES in French
10 Sep 92 p 20

[Text] Copenhagen—The Danish telecommunications manufacturer GN Store Nord (Great Northern Telegraph Company) and Telecom Denmark have signed an agreement with Lithuania's telecommunications administration Lietuvos Telekomas to install a 108-km system of fiber-optic cables. The network will be equipped with 7,680 telephone channels between Vilnius and the former Lithuanian capital Kaunas announced GN Store Nord on 7 September.

The agreement was signed 2 September in Vilnius, and represents an investment by the three partners of 20 million crowns (which comes to as many French francs). Construction of the network, which will be the first of its kind in Baltic countries, will be completed at the end of the year. It will be the first step in a larger fiber-optics network, Baltic Link, that will connect the Baltic states

to North-South Link (NSL) in Poland. GN Store Nord's future installation of the NSL network will provide the Baltic countries with direct access to the international digital communications network.

France, Canal Plus Reach D2-MAC Agreement

92WS0832D Paris AFP SCIENCES in French
10 Sep 92 pp 18-19

[Text] Paris—After over six months of negotiating whether the Telecom 2A satellite's broadcast standard should be D2-MAC or SECAM, the government has reached a compromise with Canal Plus. The agreement shores up the pay-TV station's position in the scrambled channel market, while saving efforts to promote the D2-MAC, the European interim standard for future high-definition television (HDTV).

The terms of the accord announced 7 September stipulate that the Telecom 2A satellite, which also beams telephone and military transmissions, will broadcast seven scrambled channels using the current SECAM 4/3 standard and format, and four stations in D2-MAC-Eurocrypt in the 16/9 "cinema" format.

The compromise ends a tug-of-war that lasted over six months. Consumer electronics manufacturers (Thomson, Philips) wanted to sell their new 16/9-format television sets. The government intended to promote the European HDTV standard. Canal Plus's CEO Andre Rousselet, who owns stock in the station's package of programs, was anxious to retain control over the Synter decoders that the scrambled channel developed itself. In contrast to Canal Plus's scrambling system, Eurocrypt is an "open system," and thus available to different manufacturers.

The four channels broadcast in 16/9, which will go up on the satellite around 15 November, are France 2 (the former Antenne 2), Canal Plus, Cine-Cinema, and—the only programming to be broadcast exclusively in D2-MAC/16/9—a future station which for now is dubbed Canal ++.

Telecom 2A was originally to have been reserved entirely for D2-MAC, but its channels remained empty except for a few sporting events that were rebroadcast in 16/9. According to Mr. Zuccarelli, the solution struck enables France to be the first country to offer "such a wealth of programs in 16/9." In mid-1993 and not counting Canal ++, Telecom 2A's different channels should offer 20 hours of programming in that format each day.

Television viewers, who will be receiving the programming via satellite dish, will have to juggle the different types of equipment: a satellite tuner in all cases (integrated into or separate from the decoder); a Canal Plus Synter descrambler to subscribe to the package of programs in SECAM only; and a Eurocrypt decoder to subscribe to 16/9 channels.